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EDITORIAL NOTES—GAS, &c.

The South Metropolitan Rating Decision.

INTEREST is revived in the decision in the recent rating appeals, in the County of London Court of Quarter Sessions, of the South Metropolitan Gas Company. The decision was an unfortunate one for, not only the appellants, but for all gas undertakings, particularly those in the Metropolis. We have already discussed the points then at issue, and have no intention of returning to their consideration at present. The constitution of the Court during the hearing of the appeals is, however, open to question; and the South Metropolitan Company have, through this opening, made the first move, in the King's Bench Division, towards an endeavour to get the decision quashed. As the ground of their application, they submit the disqualification of Mr. Willoughby, one of the Justices who heard the appeal. As Chairman of the Holborn Assessment Committee, who have to deal with the assessment of properties of the Gaslight and Coke Company, it is contended that there is the possibility of bias on the part of that gentleman; he having a common interest with all other assessment authorities in the Metropolis. The great question in dispute in the appeal was the amount of tenant's capital that should be allowed; and it will be remembered that the Court was resolute in declining to abide by the customary (at that Court) allowance, or to give implied sanction to any other figure by naming it. It will further be within recollection that certain remarks were made from the Bench which, if they stand, can only have the effect of instigating further rating troubles in the Metropolis. Upon the submissions of Mr. Danckwerts, K.C., for the Company, Justices Darling and Lawrence considered that the question raised is such a grave one upon a point as to which there seems to be so little authority, that they granted a *certiorari* to bring up the decision, though they expressed no sort of opinion on the case. We mention the matter here without any comment, in order to give, in view of the widespread interest that the decision on the appeal evoked, this application on the part of the Company due prominence. Their action will sharpen curiosity; and the result of the next stage of the matter will be looked for with peculiar eagerness.

Coalite Gas.

THERE are two distinct varieties of "coalite" gas. One has permeated the advertising columns of the daily press during the past few weeks to such an extent that the public is exhibiting marked indications of nausea, which is evidently a symptom of this as of other types of gas poisoning. The other has been described in glowing terms, but few have been privileged to make its acquaintance. It is only by comparison with a more or less mythical or obsolete coal gas that the latter variety can make claims to superiority. We are informed that gas-works make, from the Durham or Midland coal usually employed, on the average from 10,000 to 11,000 cubic feet of gas, having an illuminating value of between 13 and 14 candles per ton of coal, and that, in order to supply gas of a 16-candle power minimum, enrichment is needed. Let us see how these figures apply to a large gas-works where there is no question of enrichment. The South Metropolitan Gas Company last year secured an average yield of 10,960 cubic feet of gas per ton of coal, and we know that over a period of two months at the beginning of this year the illuminating power averaged 16·15 candles ["JOURNAL" Vol. XCVII., pp. 591, 801]. It is true that it dropped once as low as 14·3 candles, but even enrichment did not avail to prevent the neighbouring Company (working under a 16-candle power minimum) having as low a record as 14·83 candles. It thus appears that very nearly 11,000 cubic feet of gas averaging over 16-candle power is obtained from coal by ordinary gas-works processes.

We are told that "it would be a great advantage to the "public were this high illuminant (coalite gas) used for en- "richment in place of carburetted water gas." As a fact, however, carburetted water gas is no longer used to any extent as an enriching agent; but it is largely employed as a partial substitute for coal gas, because its manufacture relieves the market of a quantity of smokeless solid fuel, of which the supply—even without coalite—greatly exceeds the general demand. Could "coalite gas" displace this carburetted water gas or its equivalent volume of coal gas? A ton of coal yields only about half as much "coalite gas" as coal gas; but the illuminating power of the coalite gas is from 18 to 20 candles (according to Mr. F. D. Marshall, it averages 20 candles). The gas, however, contains 1 per cent. of sulphuretted hydrogen (which a public gas supply must *not* contain), 3·45 per cent. of carbonic acid (which the public certainly do not want), and 0·72 per cent. of oxygen and 9·28 per cent. of nitrogen (both obtainable from the atmosphere for nothing). By a curious coincidence, the oxygen and nitrogen together amount to exactly 10 per cent. Round figures are convenient; and we would suggest that exactly 5 per cent. of oxygen and nitrogen would make coalite gas better comparable with coal gas, and more acceptable as a constituent of public gas supplies. When the sulphuretted hydrogen, carbonic acid, and surplus oxygen and nitrogen have been deducted, the average yield of gas will fall from (say) 5500 cubic feet to less than 5000 cubic feet per ton. A neighbouring gas-works might be willing to purchase a limited quantity of this coalite gas at a moderate price—say, 9d. per 1000 cubic feet of the *purified* gas delivered as required into the gas-works' holders. But it must not be forgotten that the gas-works commands the situation. It may refuse to take any coalite gas; and if it takes any, it will be at its own price! And in regard to supply, it certainly could not afford to run any risks.

What alternative market is there for coalite gas? We are told that the gas, being simply a bye-product, can be sold at such a price as to render it possible to produce power at a very cheap rate. This means that under certain favourable conditions and in certain localities, a proportion of the gas may be disposed of at a cut-throat price, just as blast-furnace gas and Mond gas are now sold in a few places. But a condition of such sale would necessarily be the ability of the coalite works to supply sufficient gas at any moment to meet the maximum call of a fluctuating demand for it; and hence it must be prepared to produce a big surplus of a product which is too voluminous for economical storage. The surplus at least must be wasted. The alternative is to make the manufacture of coalite subservient to the demand for the gas, and let coalite become a bye-product of the manufacture of coalite gas just as coke is a bye-product of ordinary gas manufacture. But that is a condition of things not contemplated by those who are advertising the merits of coalite and its bye-products, including 20-candle-power gas. The gas will, in fact, be in the position of an unstorable or perishable waste product, only saleable in a few directions in strictly limited quantities. It may be virtually neglected in computing the returns from the bye-products of coalite manufacture. The other variety of coalite gas mentioned at the beginning of this article will be a far more valuable asset to the manufacturers of coalite. The promoters of Coalite Limited clearly hope to profit, and substantially so, by its wide dissemination.

But if coalite manufacture yields less gas, it is to yield more tar than gas manufacture. It matters not that there is already an over-production of tar, and that coke-ovens and blast-furnaces are ready to supplement the present output to an almost unlimited extent whenever the price obtainable affords them the slightest encouragement. Coalite tar is to come in quantity on an already depressed market, to fetch what it can in competition with gas tar, oil tar, oven-tar,

blast-furnace tar, and petroleum products. The German colour works will be glad to be able to buy benzols and anthracene at lower prices; but they will not for choice buy these products as derived from coalite tar because the low temperature of production will entail much contamination with paraffin hydrocarbons, which are the *bête noire* of the colour maker. As to the motor-spirit which is to be made from coalite tar, and is to displace petrol derived from petroleum, we believe the Standard Oil Company are capable of meeting any such competition. If this were not the case, motor-spirit derived from the carbonization of coal would have already been more freely used by car owners, for the sources of supply are tolerably abundant. But till recently the price of petrol has been too low to encourage the output of the native product; and the petroleum magnates will prevent such a rise in price as would tend greatly to increase that output. The believers in the coalite process as the future source of supply of our motor-spirit should study the "History of the Standard Oil Company" as narrated in two entertaining volumes by Miss Ida M. Tarbell, in order that they may grasp the nature and methods of the competitor with which they will have to deal. The study will also throw light on the prospects of lubricating oils from coalite tar. Fuel oils are also to be produced in large quantities from that tar; but fuel oils derived from coal tar, blast-furnace tar, oil tar, and petroleum are already over-abundant, and no price worth the obtaining awaits any new oil which is valuable only as fuel.

Perhaps the most interesting item of technical information anent coalite divulged during the past week is that it is made in iron boxes or stills. Well, coal gas and gas coke were at one time always made in iron retorts; and if there should be a demand for gas or coke so made, no patent rights stand in the way of the gas manager who wishes to revert from the fire-clay to the iron carbonizer. We are glad to see that Dr. Grossman has taken a similar view of the position in an article in the "Manchester Guardian" for May 28. He concludes thus:

> If it should be found that the public is willing to pay the price of coal for porous coke, it is more than probable that gas-works could produce it more cheaply than anyone else without infringing any patent. And if the Syndicate which at present owns coalite were at any time to expand into a large company, it might be well for investors to make careful inquiries not only with regard to the legal validity, but particularly to the technical tightness of the patents, as the patent rights are the principal assets which can be offered to them.

Expansion into a large company is, as was reported in the "JOURNAL" last week, imminent, and prospective investors should take this advice to heart.

Alkali Works Report—Sulphate of Ammonia.

CONSISTENT with precedent, the latest report of the Chief Inspector under the Alkali, &c., Works Regulation Acts (Mr. R. Forbes Carpenter) is replete with interest and instruction. Mr. Carpenter's annual work is always worth the most ample study; and those who are concerned in the processes of manufacture with which he deals cannot go far astray if they look upon him and the District Inspectors as guides, philosophers, and friends, and not as functionaries whose prime and sole duty is to compel and preserve certain conditions under the authority which they hold. They seek for mutual respect and helpfulness between the owners and themselves, and not mistrust; and such attitude cannot fail to have, as it is having under Mr. Carpenter's direction, most potent effects. The report supplies an accumulation of valuable experience, which could not be obtained in any other way; and this annual accumulation of experience, we believe, has had an inestimable influence upon progress in efficiency, and avoidance of nuisance and danger. The present report shows this. Modern improvement and the attainment of maximum efficiency are delineated in all sections of the document as the trend in the manufactures treated upon. The scope of inspection has been enlarged by the Alkali Works Act of 1906, which came into operation on Jan. 1 of this year; but the increase of labour which this will impose upon the inspectors is not likely, with men so heart and soul in their work, to inure in any way to a depreciation of their service. It will be of advantage to all gas-works managements to note the additional processes which the new Act embraces, and also the rules attaching to registration and the penalties for non-compliance. The points affecting gas-works will be found set forth in our *résumé* to-day of the Chief Inspector's report.

Speaking generally, sulphate of ammonia manufacture has given the inspectors very little trouble during the past year. Improvement has not been stayed in either the plant or method; and this, combined with a strict attention on the part of owners to detail so as not to cause offence, calls for praise in more than one of the district reports. There were, in fact, only two cases in which proceedings had to be taken on account of serious escapes of noxious and offensive gases in the manufacture of sulphate of ammonia; and they were entirely due to the neglect of obvious and necessary precautions. There is no excuse for allowing the emission of sulphuretted hydrogen by the use of faulty condensers, by any want of care in connection with the oxide of iron purifiers, or through badly-fitting plugs; and when these, or any of these, conditions are allowed to exist, the wisest course when found out is to pay up, as was done in the cases referred to, and not trouble to contest the matter. A noticeable feature of the present reports is the extended favour shown to open or heap oxide of iron purifiers. This method of purification has many points to commend it—such as the longer life of the oxide, the safety of re-charging, the indifference of the heap purifiers to wet weather, and the ease with which their condition can be tested. But care has to be taken in their design and location—in design, so as to get a proper distribution of the gases through the oxide; and in location, so that the heap is not exposed too much to strong winds. Where they are so exposed, there is a tendency to rapid fouling of the oxide on the lee side; and the only way, in such a case, to withstand this is to have the heap of considerable dimensions. A somewhat sheltered, but not too sheltered, position is desirable. It is not a bad thing, too, to have a reserve heap; so that there can be a change over to allow of revivification. But, of course, this would not be necessary with small sulphate of ammonia plants, where the quantity of liquor to be dealt with only allows of intermittent working.

The difficulties that have arisen with local authorities over the disposal, by way of the sewers, of the spent liquor of sulphate of ammonia manufacture, owing to the presence in it of sulphocyanides and phenoloid bodies, which are found to be destructive in the bacterial system of sewage purification, need not, it is quite apparent, now continue. In the previous report, allusion was made to this trouble in the case of two sulphate plants; and we learn from the present report that, in both instances, the adoption of the Radcliffe process for the precipitation of the sulphocyanides has been adopted, and there has been no further trouble. It is satisfactory to have this confirmation of the excellent results achieved by the system as already reported in the "JOURNAL." It is interesting also to hear that Dr. Gilbert Fowler, of Manchester, has been experimenting on the subject; and has to a great extent, if not entirely, succeeded, by a specially designed method of filtration, in obtaining an effluent which could be discharged into sewers and in certain circumstances into streams without detriment. We are glad to see this extended investigation into the subject; for sulphate of ammonia makers will give hearty welcome to any relieving system that is at once simple, efficient, and economical.

It is evident that the district inspectors have been busying themselves, too, in impressing upon manufacturers of sulphate of ammonia the importance of even more careful attention than hitherto to the prevention of the escape into the atmosphere of the noxious gases given off, owing to the presence of hydrocyanic acid adding to their poisonous and dangerous nature. Inquiries are being prosecuted into this subject; and it is quite likely that in subsequent reports we shall hear more of it. In Mr. Young's report from the North of England district, he emphasizes the point; and he seems, from his observations, to insinuate that manufacturers are inclined to be a bit sceptical as to the gravity of the question, and to look unsympathetically upon the precautions of experts. Manufacturers of sulphate of ammonia fully know the dangerous and poisonous character of hydrocyanic acid; and they rather pride themselves on the efficiency of their methods. That they are efficient in this respect, may be taken to be certified by the immunity from accident, and also by Dr. A. C. Fryer's report for the South-West of England and South Wales district. In his report, he states that several oxide of iron purifiers have been tested, at the time sulphate production was proceeding, to ascertain if any hydrocyanic acid gas was passing through them. In only one case was any of the poisonous gas detected; and that was at a plant which was not working in its normal condition. The water supply had been suddenly cut off; and

consequently the condenser was not doing its duty, and the oxide of iron was steaming. Therefore the conditions are satisfactory, so long as the plant is in proper order.

Another feature of the report which will arouse interest is that referring to the production of sulphate of ammonia and the sources of production. Putting gas-works on one side and all the other sources of output on the other, gas-works still take the lead. But their supremacy in this regard is threatened; for the aggregate output of other sources is slowly but surely creeping up, while the rate of increase in production of the output of gas-works is declining. As a matter of fact, in the district comprised of the North and East of Lancashire and part of Yorkshire, there has been a slight falling off in the production; and this is attributed partly to the extended use of water gas, and partly to the crude liquor being sold for working up outside the district. The total of 157,160 tons of sulphate of ammonia produced by the gas undertakings of the United Kingdom last year was only about 1200 tons in excess of the production in 1905; and yet we hear from time to time of the continued adoption, in the smaller gas-works, of sulphate of ammonia manufacture. But this increase in plants, of course, only shifts the scene of dealing with the ammoniacal liquor, and does not necessarily increase production. Regarding the point as to other sources of production combined—iron-works, shale works, coke-ovens, producer gas and carbonizing plants—drawing up to the gas industry in yield, their total figures for the past three years establish it: 1904, 95,782 tons; 1905, 113,157 tons; and 1906, 132,231 tons. Coke-ovens have shown the greatest progressive speed—their production having been more than doubled in the three years; and there are no signs of the activity in this direction abating. Improvements in carbonizing methods have also increased the production per ton of coal. In the shale-works this is found. In the past decade, the yield per ton of shale has risen from 37·4 lbs. to 42·7 lbs.; and this experience is that of the other contributory sources outside the gas industry. The increases in total production are not so marked in the iron-works, shale-works, and producer gas and carbonizing works; but in the year the two latter were separately superior in this respect to the whole of the gas undertakings.

There are many other matters of sterling technical worth in the report—such as the conditions affecting the formation of ferrocyanides in sulphate of ammonia saturators, and the laboratory investigations concerning the amount and distribution of cyanogen compounds and their estimation both in liquors and in their distillation products. In this connection, Mr. Linder's valuable work towards the perfection of analytical methods for ammoniacal liquors receives the prominence it richly deserves. Some practical notes are also given as to the value of pyrometry in carbonizing work; and here we find Mr. John Bond, Mr. W. R. Herring, and Professor Lewes are laid under contribution.

Torpidity in Parliament.

THINGS appear to be in a bad way in Parliament. No great progress is being made with public work; and no conspicuous haste is being evinced in getting through the opposed Private Bill work. It has been proved that a big majority, when constituted of incoherent parts, is not a desirable thing from the point of view of a Government. Instead of, as was feared, this big majority trampling down all obstacles with elephantine foot, obstruction to the Government's plans and measures has been more acute and effective from the midst of the majority than from any other quarter. Nobody seems really pleased with the present condition of affairs. Already a number of public measures have been strangled, or have been abandoned without even seeing the light of day. There were mentioned in the King's Speech at the opening of the session thirteen subjects that the Government thought ripe for legislation; and subsequent additions raised the number to sixteen. Seven most important ones, through unbending antagonism or through a wise recognition that their pursuit is hopeless, have been deserted—among them being the questions of labour in mines and property valuation. It was suggested some little time since that the report of the Departmental Committee who have been considering the question of the reduction of miners' hours in relation to the restriction of output and the effect on the country's industries would be too late for any effective legislation on the subject this session; and so, though nobody will be any the worse, it has turned out. The coalowners were therefore a little "too previous" in suggesting protective clauses for themselves in contracts, covering the additional expense which they calculated, with varying result, such a statutory limitation on miners' hours would put them to. But there are nine Bills that the Government hope to squeeze through the remaining period of the session; among them being the Finance Bill and the Amendment of the Patent Laws Bill. The former must be dealt with; and the latter is not likely to give much trouble by either side of either House. The next really interesting event in the Commons is to be the attempt that is to be made by the Government to do something or other to set the House of Lords in what the Government conceive to be its proper position. But whatever ideas the Government may be harbouring in this direction cannot have very much effect in depriving the House of Lords of the right to revision of legislative proposals, and the right to listen to the country's appeals. What the Government will do can only be in the nature of a little beating of the big drum, or a little playing to the gallery; and the Upper Chamber will sit the while unperturbed. Private Bill work is moving leisurely along. We have not since the reassembling of Parliament after the Whitsuntide recess been able to pick up a crumb of interest in connection with gas measures; and only last week the empanelling of Committees was again taken seriously in hand. A Lords Committee, who commence their sittings to-morrow, have had a long list of Bills referred to them; among the gas measures being that of the Hull Corporation (in which is contemplated the purchase of the East Hull Gas Company's works), and that of the Worthing Gas Company, over which, both in the Lower House and in Committee, there has been much discussion regarding the question of site. The news that has been received with the greatest approbation by members of both Houses is that the Government are not going, this year as last, to have an autumn session.

Hints on Share-Selling.

Investors are warned to exercise care not only in subscribing for shares in new gas undertakings but in purchasing shares through the inducements held out in attractively worded advertisements in local newspapers. Such advertisements may be genuine; they may not be. The shares offered may have sound prospects; they may not have. But warning is issued because we have a very decided opinion that the similar advertisement that has been inserted in certain provincial papers is merely a new way of palming-off on to the public the rubbishy shares that were unsubscribed for on the issue of the South Luton District Gaslight and Coke Company, Limited, about which unpromising concern we had something to say at the time it was submitted to the public in glowing and deceptive guise. There is no end to the resource of these company promoters for getting hold of the money of the public. Readers need only compare the two following advertisements to arrive at the conclusion that we have done

From the "SOUTH ESSEX WEEKLY NEWS."

GAS SHARES FOR SALE.—25 Six Per Cent. PREFERENCE SHARES of £5 each (fully paid) in a Provincial Gas Company. Purchaser will receive full benefit of dividend payable in July next. Would sell all or part. Price £4 15s. per share, or £115 the lot. The shares can be lodged with any bank or at the Company's office against payment.

From the "MANCHESTER GUARDIAN."

GAS SHARES FOR SALE.—Advertiser is compelled to realize 25 Six Per Cent. PREFERENCE SHARES of £5 each (fully paid) in a Provincial Gas Company. Purchaser will receive full benefit of dividend payable in June next. Would sell all or part. Price £4 15s. per share, or £115 the lot. The shares can be lodged with any bank or at the Company's office against payment.

We should like to know whether the Miss L. Thompson who is in need of immediate cash, and will accept £115 for her 25 £5 fully-paid 6 per cent. cumulative preference shares, or is willing to sell at £4 15s. per share, is any connection of L. Thompson, whose name appeared on the prospectus of the Kent County Gaslight and Coke Company as Secretary. We are only curious owing to the similarity of names, and the coincidence that a paragraph in the Kent County and South Luton prospectuses were almost identical. It is also singular, too, that Miss L. Thompson should have lodged her certificate with the Secretary of the South Luton Gas Company, at No. 19, Market Hill, Luton. Still, if any reader decides to purchase will he please write to the Secretary of the Company direct, as the lady has arranged with him to carry the sale through for her. That is very nice of the lady, and kind of the Secretary. It is also very thoughtful

of Miss Thompson to send an inquirer for the shares copies of the prospectus, and a typewritten extract from a fresh report by Mr. Frederick Pontifex, Consulting Engineer and Valuer, in which he states that he was at the works on Tuesday, the 14th inst. [apparently as recently as May 14], that 561 feet (!) of additional mains have been laid in the side-streets of Markyate, that connection with the old main is to be made forthwith, that a 4-inch main towards Flamstead is now being laid, and that the materials for the concrete for the foundations for the new "utensils" will be procured at once. Who are buyers of 25 £5 fully-paid cumulative preference shares in the South Luton Company for £115?

Differential Prices.

In an article dealing with rates for electric power, published in the "Manchester Guardian" a few days ago, it was argued that the method of devising a flat-rate to apply equally to all customers is not suitable to a modern electricity undertaking, and that the wide variation in the prices which may be justly demanded from customers is due to the influence of capital and other fixed charges. But when the case of gas was considered, it was contended that the supply is not so greatly influenced by these fixed charges, largely because of the existence of the holder for dealing with fluctuations. While, however, admitting the reasonableness of instituting differential charges for electric current, Mr. T. G. Marsh (who has been devoting a considerable amount of attention to championing the cause of cheap gas) felt himself quite unable to see that the same course was not to be commended in the case of gas; and in a letter which appeared in a subsequent issue of the newspaper in question, he dealt at length with the commercial disadvantages of a flat-rate in gas supply. Having set forth the desirability of finding some means by which as large a sale of gas per consumer could be secured as was the case before the introduction of the incandescent mantle, he proceeded to argue that this end could only be obtained by the popularizing of gas cookers and fires, and that there should be as large a reduction as possible on the gas used for fires, trade heating appliances, and engines. As to the question of fixed charges, two cases were quoted in Mr. Marsh's letter, in which the cost of a plant to supply gas would not, he said, be more than one-fourth that needed for supplying light consumers using an equal yearly volume of gas, but requiring it mainly during the winter months. One of these instances was that of a firm of wire-workers consuming, winter and summer alike, at the rate of some 6 million cubic feet of gas per annum for the purpose of tempering, and the other a firm who used at their works and their branch works about 10 million feet of gas for heating tin-plate workers' stoves. Surely his is another case in which "what is sauce for the goose, is sauce for the gander." If differential prices are good for electricity, why should they not be at any rate equally so for gas.

A National Federation of Ratepayers.

A considerable step was taken last week in the direction of organizing concerted action by ratepayers against those frequently manifested tendencies of local governing bodies to which private opinion is so extensively opposed, by a meeting held in London of representatives of ratepayers' associations and similar bodies throughout the country. The gathering was largely attended; and the object of it was plainly set forth by the Chairman, Mr. Featherstone Witty, of Bristol, in the remark that "the time had come to take steps to prevent reckless enterprises of the municipal trading order from being carried on as they were at present." Instancing his own locality, he said five-sevenths of the civil debt had been incurred through following undesirable policies, which were a means of increasing the rates tremendously. There were the docks, and an electric light undertaking, which was "worm-eaten with financial rottenness, and would ultimately totter to the ground." All these things, he added, were urged by gentlemen impregnated with theories—Socialists. A resolution was adopted approving of the principle of a National Federation of Ratepayers; the idea being to amalgamate the various London and Provincial bodies, and to establish a central organization in the Metropolis. The plan appears a good one; for united action is necessary to achieve any lasting result. But whether the general body of ratepayers will offer the necessary support to the movement to make it a real success, remains to be seen. It is to be hoped they will; but there is much hard work to be done. This was admitted at the conference by Mr. E. E. Robb (of Hammersmith), who said they must not forget that the ordinary Ratepayers' Association, as it existed to-day, was (with certain exceptions) a body of not much potency. They had to infuse into the local bodies the necessary life and backbone; and they would have to be powerful enough to deal with organizations which were able to use the ratepayers' money to fight the ratepayers. If, he added, their Federation was to be effective, it must be on broad lines, and handled by men of broad opinions. The promise is good; may the performance be equally so.

PERSONAL.

Mr. R. H. S. Williams, Assistant Gas Manager at Barrow-in-Furness, has been appointed Gas and Water Engineer to the Tyldesley Urban District Council. Mr. Williams was selected out of 25 candidates.

Referring to the announcement (*ante*, p. 665) of the resignation by Mr. Joseph Jervis of the position he had held for some thirty years (not twenty years, as stated last week) as Secretary of the Eckington Collieries of Messrs. J. & G. Wells, Limited, we are pleased to learn that the officials and staff presented him with an illuminated address on his retirement.

From remarks made after the inspection of the Longwood Gas-Works last Saturday by the members of the Manchester and Yorkshire Junior Gas Associations (an account of which appears elsewhere), it will be seen that Mr. G. W. Fligg, the President of the Yorkshire Association, has been promoted to the position of Engineer and Manager of the Dewsbury Corporation Gas-Works, in succession to Mr. C. A. Craven, whose resignation was announced in April.

Workmen's Compensation Act.

"X" writes: "Nearly all gas managers will be seriously considering the far-reaching enactments of this extended Act of Parliament, which comes into operation on the 1st of July next; and probably many, like the writer, have been making inquiries as to insuring against the liability. The Insurance Companies for the most part seem to have formed a ring and are all quoting equal prices for the risk. They are asking 17s. 6d. and 12s. 6d. per cent. for labourers and fitters respectively, and 3s. for the clerical staff. Such a charge becomes a serious tax on any company; and, personally, I consider should be resisted. In my own case, the premiums asked are altogether out of proportion to the risk incurred, judging from experience gained and the smallness of claims made during the working of the old Workmen's Compensation Act. Cannot something be done at the Gas Institution meetings in Dublin? Gas companies, if in combination, should be strong enough in the matter of wages either to make better terms with the Insurance Companies or to effect their own insurance. I think it only requires someone to take the initiative, when probably most of the Gas Companies in the country would gladly fall into line."

Leek Gas Statistics.—The President of the Manchester District Institution (Mr. William Prince) asks us to say that in the report of his remarks at the luncheon at Leek, which appeared in last week's "Journal," p. 651, his statement about the "enviable and unique position" in which the Leek Town Council found themselves in the matter of their gas undertaking should have read that they have a capital of only £3 per ton of coal carbonized, not £3 per million cubic feet of gas manufactured.

A Further Opportunity for Investors.—The North-East Lincolnshire Water Company are issuing, by tender, £13,000 of 6 per cent. preference stock, at the minimum price of £9 per £10 stock. That is an attractive feature, which is accompanied by the further sop of a full six months' interest on Aug. 1 next. Less attractive features to some investors will be that the Finance and Construction Company, Limited, are interested parties, and that this Company's generosity, in view of certain consideration in one of the agreements with the Water Company, has led them to guarantee the payment of the interest upon the preference stock for two years from Feb. 1 last. The guarantee we imagine is no measure of the consideration.

"Field's Analysis" for 1906.—Another issue of this carefully prepared and equally carefully studied compilation has been reached by the publication of the returns for 1906. This is the thirty-eighth volume of the statistics, which are still called after their originator, the late Mr. John Field, though they are now compiled by Mr. George Orford, the Assistant Accountant to the Gaslight and Coke Company. It is quite unnecessary at this time of day to point out to anyone who is at all intimately connected with the gas profession what is the nature of the information afforded by the work. All that is needful is to state that the book is now ready. In addition to the three Metropolitan Gas Companies, the undertakings dealt with include twelve Suburban Companies, nine Provincial Companies, one Irish Company (the Alliance and Dublin), and eleven Corporations, inclusive of Edinburgh and Glasgow.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 761.)

THE storm raised by the May-end account was of proportions calculated to last some time before abating; and the atmosphere of the Stock Exchange last week was still in a state of disturbance. It was at once apparent that the resulting difficulties were by no means adjusted, and enforced realizations made markets very flat. On Tuesday, things were for some time equally depressed; but before the close a little recovery set in. Consols, however, did not share in the improvement. Wednesday was a very quiet day—the counter attractions of Epsom being powerful; but in spite of inanition things were really a bit firmer. Thursday was disturbed by Continental apprehension of trouble in Russia over the Duma, and in France over the wine growers; but it calmed down afterwards. Friday was much upset by another failure for which the House was not prepared; and even the brighter turn taken by one or two lines could not remove the gloom. On Saturday, the tendency was no worse—indeed, if there was any change, it was for the better—and relief was felt at no further casualties over the account being reported. Prices were generally steady, and the look-out was regarded as being much more hopeful. In the Money Market, there was a fair demand for short loans, but no real pressure; and discount rates were mostly firm. In the Gas Market, the aggregate of operations showed a very decided increase over the record of the previous week; but by far the larger bulk of them was in the three biggest issues—the small fry being almost wholly neglected. There were not many changes in quotation; but the general tendency was flat. In Gaslight and Coke issues, the ordinary was pretty brisk. On Monday and Tuesday, 92⅜ was obtained; but from this point the price weakened down to 91⅛—the quotation showing a fall of 2. But a little was done in the secured issues; the maximum marking 87½ and 88¼, the preference from 102½ to 103¼ (a fall of 1), and the debenture not being dealt in. South Metropolitan was fairly active, with transactions ranging from 123⅛ to 121½ (the quotation falling 1); and the debenture changed hands at from 83½ to 84½. Nothing at all was marked in Commercials; but at the Mart on Tuesday a new issue of £50,000 of 4 per cent. stock was offered and taken. In the Suburban and Provincial group, Bournemouth marked 28, Brentford old 251, Brighton original 220, British 42 free, North Middlesex 7 per cent. 13 special, South Suburban 120, and West Ham 104½. In the Continental Gas Companies, Imperial was active at prices ranging from 167½ to 169 (a rise of 1); and Union marked 116. European fully-paid marked 24⅛ and 24 (a fall of ½), and ditto part-paid 18¼ and 18¾. Cagliari was done at 26, and Malta at 4¾. Among the gas undertakings of the remoter world, Buenos Ayres changed hands at from 11 to 11$\frac{7}{16}$, ditto debenture at 95½, Primitiva at 6$\frac{13}{16}$ and 6$\frac{15}{16}$, Monte Video at 11, and Melbourne 5 per cent. at 101½.

ELECTRIC LIGHTING MEMORANDA.

Gloom in the Electrical Industry—Undesirable Neighbours—A Two-Rate System of Charging—Depreciation Provision an Economic Financial Process—The Difficulties of the Tungsten Lamps.

"ELECTRICAL engineering seems never to be free from some irritating or aggravating complaint." Unlucky electrical engineering industry! Its present position gave cause for the writing of the quoted sentence in a recent editorial in the "Electrical Review." And the present position is not the only cause for melancholy, but the future. Commercially, electrical engineering has been overdone; and even when construction business was at its greatest height, competition was so severe that profits had to be finely drawn. The position now is that, in the cities and larger towns, equipment has to a large extent been completed; and there is an acute scramble for extension and renewal work. This applies not only to electricity supply works, but also to tramway equipment. The shareholders of the Brush Electrical Engineering Company are this year without dividend; and the Company are spreading their basis, by going into other highly competitive businesses, to try and realize profit somewhere and somehow. From electrical equipment, they passed into the manufacture of tramway rolling stock; the diminution of this business has led them into the turning out of railway rolling stock; and now, in the onward march, they have taken up the manufacture of omnibuses and commercial motor vehicles, as though there were not already enough companies of a more or less promising or unpromising nature in the industry. The Australasian branch of the Company's business, owing to accumulated losses and increasing competition, has had to be closed down, and only an agency established. Foreign markets, it is complained, are not open to the British electrical industry on terms of equality, while foreign competitors are as free in this country as they are in their own countries and in our own colonies. But that is not the full sum of complaint. Electrical legislation, the tardy development, through want of appreciation, of the electrical power and bulk supply companies, and the high price of copper, are all arraigned as contributory causes of depression. But there they all are; and what can be done to relieve the situation? Mr. Garcke says that, until general conditions improve, it is very doubtful whether electrical manufacturers in this country can secure the full profit to which they are entitled. But are "general conditions" bad now? Most industries are very active, and trade generally is good. If Mr. Garcke is right, then we fear the prospect is just as gloomy as the existing state. The conditions that want remedying are within the electrical industry, and not outside. The fact is the producers of plant are too many for the demand.

Electricity generating-stations are not considered desirable neighbours. At the recent annual meeting of the Smoke Abatement Society, some alarming things were said about the injurious effect of the emissions of the chimneys of such stations upon buildings of national importance—certain cathedrals being cited. The Commissioners of Works have long entertained antipathy to electricity generating-stations in London; and they are evidently going to try to make their voice more effectively heard in the matter. In their General Powers Bill, the London County Council are asking for an extension of time for the carrying out of certain improvements, including the public gardens in Westminster near the Victoria Tower. The demolition necessary to their plans involves the generating-station of the Westminster Electric Lighting Corporation. A site for the station has been found in the Horseferry Road; but there is a hitch in the negotiations over the question of compensation. The Commissioners of Works have got wind of the site chosen, and have stepped in, and urged upon the Committee of the House of Commons to whom the Bill was referred the necessity of including provision to prevent the increasing danger arising to buildings of art such as the Houses of Parliament and the Tate Gallery from the proximity of generating-stations. As their intervention was too late in the Commons, they are holding themselves at liberty to take action in the House of Lords. If the Commissioners persist in their intention, the contest will not be without its interest; and if they are successful, the result may be rather serious for the Electricity Corporation or the County Council. It is rather an uncomfortable thing for electricity suppliers to have these continual reflections upon the noxious character of their chimney ejections; but libelling gas as they do, is the sympathy of gas people with them deserved?

Punch's advice some time ago to those about to marry was "Don't." The similar advice of all well-wishers of the electrical supply industry should be given to central station engineers in connection with the matter of charging. There has been from time to time a marvellous amount of ingenuity displayed by these gentlemen in devising systems of charging that, it has been hoped, would tempt new custom, and quell dissatisfaction. But, with all the expended trouble, it passes the wit of ordinary consumers to unravel the true intentions of the inventors of these systems. To mystify consumers where the pocket is concerned does not pay. A letter in the "Electrician" just lately informs that certain enterprising station engineers are going a step further, by the adoption of a two-rate system, in which a clock controls the mechanism of a meter with two dials. The writer explains that "the restricted or high-rate period is variable, and usually on these lines: January, 5 a.m. to 8 p.m.; February, 5.30 a.m. to 8 p.m.; March, 6 a.m. to 8 p.m." Confusion and annoyance, and a lowering of peaks and possibly of valleys in the consumption chart, are the terrible things predicted, by this correspondent, to result from the persistent efforts in this direction by station engineers. We incline to similar belief. But the same correspondent has his own little fancy. He submits that "an arrangement of charging a price per kilowatt of demand, taking the place of the objectionable meter-rent, would give satisfaction." That we also are inclined to doubt. Like electricity consumers, we have a fancy for the old-fashioned flat-rate.

Recently reference was made in the "Memoranda" to an article that had appeared in the "Municipal Journal," and, in the course of our comments, it was submitted that "when a business is started and run on borrowed money which has to be repaid, it is an economic process to put by money in a depreciation fund for replacements." Our contemporary now submits to us this proposition: "Assuming that a local authority makes all its renewals out of revenue or a renewals reserve fund, is there, in the opinion of the 'JOURNAL OF GAS LIGHTING,' any necessity for a depreciation fund in addition to a sinking fund?" "A rose by any other name would smell as sweet;" and we have not much care whether a fund to replace depreciated plant when it reaches an aged or uneconomical state is called a depreciation fund or a renewals reserve fund. Whether replacements are charged in a lump to revenue, or are paid for from a depreciation fund, in both cases revenue bears the charges, but in the latter case with uniformity. We hold it to be sounder finance and fairer to the undertaking to spread such renewals over revenue by provision during the life of the plant than make them a lump charge on revenue at the time they are required. Our contemporary, however, takes a narrow view of renewals—meaning only the renewal of plant "the life of which has ended before the expiration of the loan period." We mean more than that—including, as we do, all plant for which capital has once been found. "Obviously," says our contemporary, "if the life of a plant coincides with the loan period, the local authority is entitled to reborrow for replacements." We admit the title, but not that it is expedient or an economic process to be borrowing again and again for replacing the same plant. If there is a fund from which the plant can be renewed, the obligations of sinking fund and interest cease when the first loan for the particular plant has been discharged; and that is financial economy.

An instructive paper has been read by Signor C. Clerici before

the Milan Section of the Italian Electrical Association on the very live subject of tungsten lamps, which, he thinks, are the ones, among the many new arrivals, that have the best chance of survival. The metal, not being ductile, cannot be drawn into wire; and so the preparation of the filaments has to be effected indirectly. This is accomplished in various ways described by the author of the paper, a translation of which has appeared in the "Electrician." As these are the electric incandescent lamps that are credited with "having the best chance of survival," readers may like to know something about the methods that have been devised for preparing the filaments. The author explains that by Dr. Kuzell's plan, the metal is reduced to the "colloidal state" by means of an arc between two electrodes of tungsten under water. By evaporation, the resulting solution is thickened till it can be worked like clay. This is drawn or squirted into a filament, which (after drying) is raised to a high temperature to weld it into a metallic filament. The second method is that of Just and Hanaman, in which tungsten is deposited on an ordinary carbon filament by a process similar to flashing as practised in carbon lamp manufacture. The resulting compound filament is heated to incandescence in hydrogen and water vapour, when the carbon disappears, leaving a tubular metallic filament. In the third method, a fine powder of tungsten is produced by chemical means. This is worked into a paste with glutinous material, and the filament freed from carbon as in the previous method. The fourth group of methods consists of the preparation of a paste of oxide of tungsten, from which a filament is made, and afterwards reduced to a metallic state in various ways.

That, briefly, is the way in which the filaments are differently prepared. We read that the filaments made in this way are very fragile, and their resistance is so low that a length of about 6 mm. is required per volt. For even a 100-volt lamp, it is necessary, therefore, to arrange several filaments in series in one bulb supported on a central stem of glass. The extreme fragility of these filaments, and their low resistance, have been known from the time that lamps so constructed made their first bow to the technical world; and the difficulty—insuperable it would seem from present knowledge—that these physical drawbacks present to the making of tungsten lamps which, in a single bulb, would be equal to a voltage of 200 and above, has been fully recognized. It being necessary to arrange "several filaments in series in one bulb, supported on a central stem of glass" for even a 100-volt lamp, it would be a wonderfully constituted piece of construction that could be made to stand 200 volts; and the more the filaments have to be multiplied, the greater the number of the seats of possible disaster to the lamp. Lamps that have to be so made must give an infinite amount of trouble in manufacture through the delicate operations that have to be performed; and so the outlook for these lamps ever being really cheap is not favourable. Turning again to the translation in our contemporary, it is gathered that the lamps exhibited by the author of the paper were of Italian manufacture, and were for 60-candle power at 100 volts. They absorb 60 watts, and consist of six filaments in series, with a total length of 640 mm., and a diameter of 0·05 mm. Efforts, it is stated, have been made to produce finer filaments; and some have been made with a diameter of 0·03 mm., which would correspond to 20-candle power for a 110-volt lamp. But it is impossible to say whether such lamps can be manufactured on an industrial scale. According to the author, too, life tests of the 60-candle power lamps show that the efficiency of 1 watt per candle power is well maintained for a period of 500 to 700 hours. A few of the lamps have run at this efficiency for 1500 and even 2500 hours; but they are evidently the exceptions to the rule. No doubt the whole of the life tests represent laboratory conditions, without being subject to the shocks of ordinary everyday use and circumstance. For instance, we read: The temperature coefficient of resistance being positive for tungsten, the resistance is less in these lamps when cold than when in use. The 60-candle power 110-volt lamps already mentioned have a resistance of 33 ohms cold and 170 ohms at the working temperature. In consequence of this, there is a rush of current on first switching on, which, in the case of a number of lamps on one switch, may cause inconvenience. The thin filament is, however, quickly heated, so that the excess current is of very short duration. It is useful to have the particulars; but these are not the lamps that are greatly needed under British conditions of electricity supply.

Mond Gas for Potters' Ovens.—For a long time past experiments have been in progress to ascertain the applicability of Mond gas to the firing of potters' ovens; and it is stated that at last these have been successful, and the possibility of adapting the gas to this purpose has been established beyond doubt. For the purpose of the experiments, an up-draught oven of the type common to the Hanley district was used; a small plant for generating the Mond gas being put down near at hand. The only change made in the oven was by the addition of an arrangement (which has been patented) by which the gas and air are admitted to the interior in such a manner as to raise the calorific power to the highest possible point. It is stated that, after many difficulties, an oven temperature has been secured of 1350° C., or 2475° Fahr.; and within the past few weeks pottery ware has been fired in the oven with complete success. Lately a demonstration took place before a number of leading manufacturers and others, and the result was declared to be excellent.

EARLY GAS LITERATURE.

The attention of readers may be drawn to the fact that Mr. F. Southwell Cripps, Assoc.M.Inst.C.E., has had reprinted in pamphlet form the list of the earliest works on gas lighting compiled by him and published in the "Journal" for the 21st ult. What are chronicled are books, pamphlets, and important references to the subject, prior to the year 1840; while there are also a diary of principal events in the early history of gas lighting, and a list of patents (between 1789 and 1840) relating to gas manufacture, apparatus, fittings, &c. No doubt, the compilation as a pamphlet will prove more handy for repeated reference than in the form of a contribution to the pages of the "Journal;" but a further purpose even than this should be served by the re-issue in the style named. In a letter which appeared in our columns last week, Mr. Cripps pointed out that there might still be omissions from his list; and he suggested that it would be of great interest if readers would furnish information from time to time, through the "Journal," of the titles, names, and dates of any books, &c., not already included. The pamphlet is provided with wide margins and blank pages at the end for notes and additions; and if the facility thus provided is taken advantage of in the manner that the author has in mind, and the result is in due course made public, it will certainly, as he says, be of interest—particularly at the present time, when perhaps more than usual attention is being paid to the "childhood" of the industry. It has only to be added that the pamphlet (which is obtainable at the "Journal" office) is priced at 1s.

THE INTRODUCTION OF GAS LIGHTING.*

Scattered here and there in innumerable books and papers, in chapters and pamphlets and articles, are to be found many historical fragments and essays dealing with the early days of gas lighting, and with the lives and doings of its pioneers. In gas text-books, both of an earlier and a later period, may be read admirable summaries of the introductory history of the gas industry. Prominent in our minds, as being more generally accessible than others, are the "Historical Sketch of the Introduction of Lighting by Coal Gas," which forms the opening chapter of Clegg's "Practical Treatise on the Manufacture and Distribution of Coal Gas" (edition 1841); the similar, but fuller, History of Gas Lighting in Chapter I. of King's well-known "Treatise" (1878); the excellent little epitomized history in Hughes's "Gas and Gas-Works;" and several other shorter and less consecutive accounts of gas in its early stages of development. The recently published and useful compilation by Mr. F. Southwell Cripps, of "The Earliest Works on Gas Lighting," shows at a glance a great many of the sources of information on the subject. The writer of the final and complete history of the rise of the gas industry will thus assuredly find sufficient material at his hand.

Mr. Charles Hunt, who, as announced last week, has written "A History of the Introduction of Gas Lighting"—thereby celebrating the centenary of street gas-lighting—has been fortunate to have new matter placed at his disposal by Mr. George Tangye, of Tangyes Limited, of Birmingham, who have done so much to preserve the name and fame of William Murdoch. Mr. Hunt is also to be warmly congratulated on the result of his labours of historical investigation, which must indeed have been spread over some years. For to anyone who has not himself essayed to ascertain the exact truth concerning any fact relating to a bygone day, it would come as a surprise to find out what an enormous amount of patient plodding is involved. That is one of the first thoughts that must strike the reader on rising from a perusal of Mr. Hunt's new book. The second impression, and one no less strong than the first (and such as one would only expect from an engineer of the wide experience and mature judgment of Mr. Hunt), is that the views put forth both of men and of matters are broadly based and pre-eminently just and fair. This is especially noticeable where the conflicting claims of men like Murdoch, Lebon, Minckelers, and Winsor are concerned.

Thus, for example, on the very first page of Mr. Hunt's book, the author says that with the industry "are inseparably associated the names of William Murdoch and Philippe Lebon, to whom we are indebted—although in different degrees—for the introduction of the art of gas lighting." Also in Chapter II., headed "Murdoch and Lebon," which contains a fairly full account of the French inventor's life and work, a tribute is paid to his "anticipation of the modern gas-engine," and to his "foreseeing the utilization of blast-furnace gases." He was an "accomplished Frenchman who, if wanting in some of the qualities that command success, was yet capable of pointing out the way by which a notable advance might be achieved." So, too, in regard to Winsor—that extraordinary man and incomparable company promoter—the author concludes the chapter that is devoted to him in these words: "To him, however, remains for all time the credit of having initiated the system of public gas lighting." And in this year of 1907, it is really the centenary of the work of Winsor that

* "A History of the Introduction of Gas Lighting." By Charles Hunt, M.Inst.C.E., President of the Institution of Gas Engineers. London: Walter King; 1907. [Price, 8s.]

should be celebrated. For this among other reasons, it seems rather surprising that Mr. Hunt did not complete the story by giving a few particulars rounding off the life of Winsor. We are told nothing about him after his Bill passed its third reading on June 3, 1810, and received the Royal Assent on June 9 following. Nothing whatever is said as to his subsequent career, death, and burial in Paris.

In fact, the whole history rather abruptly ends with the incorporation of the first Gas Company in 1812; a few paragraphs being added as to the subsequent events in the life of Murdoch till his death on Nov. 15, 1839. We feel also that there is some little meagreness in the information given about Clegg; for after all, apart from the original conception of the idea of gas lighting, it was he who perhaps did most to further its practical application. We must not, however, overlook the handsome tribute which Mr. Hunt pays him in a sentence in the last chapter, where (p. 140) he says, he "was destined to leave a mark on the history of gas lighting scarcely less enduring than Murdoch's own."

Before passing on to note the salient features of each chapter, the third impression created by Mr. Hunt's work may be stated; and it follows as a corollary from the second. It is the painstaking desire that is evidenced for accuracy as to facts. A good illustration of this is seen in the care with which Mr. Hunt has investigated the various accounts of the public illumination of Messrs. Boulton and Watt's Soho Foundry, in 1802, in celebration of the Peace of Amiens. Chiefly upon the authority of William Matthews, whose "Historical Sketch of the Origin, Progress, and Present State of Gas Lighting" was published in 1827, it has been generally accepted that gas lights were largely, and indeed almost entirely, used in that display. Matthews was an eye-witness of it; and he says "he had the inexpressible gratification of witnessing, in 1802, Mr. Murdoch's extraordinary and splendid exhibition of gas-lights at Soho." He goes on to say: "The whole front . . . was ornamented with a great variety of devices that admirably displayed many of the varied forms of which gas-light was susceptible." On the other hand, in the accounts appearing in the Press at the time, no mention is made of gas, but details of the design of the illuminations are given, in which 2000 coloured lamps were used.

Murdoch, in his paper before the Royal Society in 1808, says that at the Peace of 1802, "a public display of this [gas] light was made by me in the illumination of Mr. Boulton's manufactory at Soho." It, therefore, becomes a question as to the extent to which gas was used for the illuminations of 1802. The answer is to be found in a letter from "L.L." to the "Mechanic's Magazine" in 1834, and in the account given by Samuel Clegg, jun., in his "Treatise" of 1841. There (p. 6) he says: "Mr. Murdoch first publicly exhibited the gas-light by placing at each end of the Soho manufactory what was termed a Bengal light. . . . This was the only gas used on that occasion; the rest of the manufactory being illuminated by the usual small glass oil-lamps, and not with the gas, as has been erroneously stated." A footnote adds: "Mr. Clegg, then a pupil of Messrs. Boulton and Watt, was present and assisted at this illumination." Mr. Hunt, no doubt rightly, supports this view, and says (p. 65): "The silence of the contemporary Press on the subject; the fact that the art of gas lighting was then in its very infancy (the experiments with regard to it having been renewed only a few months previously); and the absence of a gasholder, without the assistance of which any such general illumination as that which is described could hardly have been possible—all serve to show that the early historian of gas lighting was mistaken in ascribing to coal gas the effects which impressed him so greatly a quarter of a century previous to the publication of his account of them." In view of the popular acceptation of this Soho Foundry gas illumination in 1802, we thought it right to refer to the matter thus fully; and also because it well illustrates Mr. Hunt's careful weighing of his material.

Now let us briefly glance through the five chapters which compose the present book. Chapter I. deals with "Early Records," most of which are well known; Thomas Shirley's "Description of a Well and Earth in Lancashire, taking Fire by a Candle approached to it," published in the "Philosophical Transactions" for 1667; the definitions of "Gas" by Van Helmont (1577-1644); and in Nicolson's "Dictionary of Chemistry" (1795); Dr. Clayton's letter to Boyle relating "An Experiment Concerning the Spirit of Coals;" Dr. Hales's "Vegetable Staticks;" De Gensanne's first account of the distillation of coal for industrial purposes (1770); Dr. Watson's experiments on coal distillation (1781); the lighting of Culross Abbey by gas from Lord Dundonald's tar-kilns (about 1782), and the first recorded instance of a coal-gas explosion in consequence of it; and Diller's exhibition of his "Philosophical Fireworks" at the Lyceum Theatre, London, in 1788. Minckelers (who only has two pages devoted to him) first used coal gas for inflating balloons, and he may have lighted his lecture-room with it in 1785, as is alleged. But Murdoch was the first to demonstrate the utility of gas-lighting, and "the first to show how it could be applied to the use and convenience of man."

Chapter II. is perhaps the most interesting of all in the book—dealing as it does with Murdoch and Lebon. We have presented to us vivid pictures of Murdoch in Cornwall using his Herculean proportions and muscular power to thrash a room-full of mining captains; of his being indefatigably at work, neglecting both food and bed; of his experiments with, and desires to patent, his steam road-carriage; and of Boulton and Watt's anxiety to "cure him of the disorder, or turn the evil to good," as it is quaintly expressed in a hitherto unpublished letter dated Sept. 2, 1786. But we will not spoil the other good and entertaining things in this chapter, but leave them for the reader's enjoyment.

To the following chapter, relating to "Murdoch, Clegg, and Others," we have already referred, containing as it does the inquiry into the Soho Foundry illumination. With Chapter IV., on "Winsor," as has already been remarked, we are rather disappointed; and we are inclined to think that the lengthy extracts from his pamphlets might have been better placed in an appendix. The last chapter records the "Struggle for Incorporation," and Mr. Hunt here brings out clearly the narrowness of the views of Winsor's opponents, although among them were Murdoch and Watt. The author says (p. 136): "The opponents entirely failed to grasp the significance and possibilities of the scheme propounded by Winsor. The idea of a public supply of gas lighting was beyond them; they saw no farther than a gradual extension of private installations. They took alarm at the prospect of the establishment of an incorporated Company as likely to interfere with their business." All of which shows how small great men can be, and how history—human and commercial—does not change very much through a century.

In conclusion, we must thank the author for placing at the disposal of gas students—young and old—his valuable researches, and for adding to their interest by giving so many new and interesting photographs and illustrations, which are quite an admirable feature of an entertaining and instructive book.

THE FINANCIAL POSITION OF A FEW IMPORTANT GAS COMPANIES.

[COMMUNICATED.]

CONSIDERABLY higher prices for gas coal have this year been obtained by the colliery owners; the gas companies having been forced to accede to their substantial demands. The high range of prices is not due so much to the avidity of the coal producers as the enormous demand by foreign countries, consequent on the repeal of the coal tax as from November last. The cause of the increase in coal prices is greatly to be regretted; and householders and manufacturers having had to pay higher prices for coal will now in many cases have to pay higher prices for gas—with this difference, that with coal an increased demand means increased prices, but with gas it generally means a reduction in prices, for nothing cheapens gas production so much as substantial increases in gas sales.

It is impossible to say how long the present prices for coal will be maintained, and it is fairly certain that many companies will be forced to raise their charges for gas. Some sliding-scale companies will probably have to reduce their dividends—not because, having raised their charges, their funds will not allow of the maintenance of the same rate of dividend, but because under the sliding-scale clauses there is (whether the full amount is paid or not) a fixed rate of dividends for every variation made in the price of gas.

In the "JOURNAL" for May 28 the South Metropolitan Company are reported to have bought 1,000,000 tons of Durham coal at 12s. per ton f.o.b. the Tyne. This price represents an increase of about 3s. per ton as compared with that of last year, and means a very serious increase in expenditure—amounting to about £150,000.

The following table shows the financial position of a few important Gas Companies, to illustrate the general effect on the gas industry of the rise in the price of coal:—

Name of Company.	Coal. Tons.	Extra Cost at 1s. 6d. Per ton.	Per 10·0 Ft. Sold.	Dividend Allowed.	Dividend Paid.	Margin for Rise in Price.	Balance Forward.
	£	£	d.	£ s. d.	£ s. d.	d.	£
Gaslight and Coke.	1,704,000	127,800	1·46	4 10 8	4 8 0	1·00	230,000
Commercial. . .	210,000	15,750	1·30	5 6 8	5 4 0	1·00	22,947
South Metrcpolitan	1,170,000	87,700	1·75	5 14 8	5 10 0	1·74	9,000
Brentford . . .	152,000	11,400	1·28	13 0 0	12 10 0	2·00	53,305
South Suburban .	124,000	9,300	1·66	5 3 4	5 10 0	1·33	1,826
Newcastle . . .	278,000	20,850	1·72	4 12 6	4 12 6	nil	18,198

It has been found in past years that, on the occasions of high coal prices, the increased receipts from the sales of coke counterbalance about half the extra cost of coal; and as on the present occasion this amounts to about 3s. per ton, it will be approximately correct to assume that the net cost of coal will entail an extra expenditure of 1s. 6d. per ton.

At this rate, the increased cost of production, due to the higher price of coal, amounts in no case to 2d. per 1000 cubic feet. So that, provided that coal rises no higher, the increased charges for gas are not likely to be very substantial. It will be noticed that in only one of the Companies mentioned is the maximum dividend paid; the remaining Companies having all allowed a margin of not less than 1d. per 1000 cubic feet for a rise in the price of gas. It will also be noticed that the Brentford Company have carried forward a very substantial sum—amounting to nearly four times the extra coal bill. So that it is very unlikely that their present price will be disturbed. The Gaslight and Coke Company are also fairly well situated to meet the extra expenditure, as, having

in hand a balance amounting to over £100,000 more than is required to pay this year's increased coal bill, it is not likely that the present price will be raised—especially as further improvement in working, so conspicuously shown during the past year, may be expected in the case of this Company. The Commercial Company, having a proportionately large balance in hand, are also fairly well placed to maintain their present price. The Newcastle Company will probably not raise their price, although their balance in hand is not quite sufficient to meet the extra cost of coal. But in the case of this Company, a rise in the price of gas would mean a reduction in the dividend—a procedure which should at all costs be avoided. The South Metropolitan and the South Suburban Companies will almost certainly have to raise their prices; and it is quite likely that the dividends will have to be slightly reduced. Both Companies (under the chairmanship of Sir George Livesey) have adopted a firm policy of reducing prices whenever possible, looking to increased sales to counterbalance the loss in revenue resulting from lower charges for gas, The South Metropolitan Company's district has, however, been so well canvassed in past years that the last reduction (from 2s. 2d. to 2s.) has only resulted in comparatively small increases, in no case sufficient to meet the loss in revenue.

The sliding-scale system, though ideal in almost every particular, labours under one disadvantage—that is, that on occasions like the present, unless a company working under the sliding scale are in a strong financial position, there is the likelihood of a reduction in the rate of dividends—an event which is looked on by the investing public with strong disapproval, resulting in a decline of the company's credit. But for the sliding scale it would be simplicity itself for all gas companies to maintain their rates of dividend, as 1d. or 2d. increase in the price of gas brings in proportionately a very large sum compared with that required to pay the difference between the usual dividend and the lower dividend allowed owing to an increase in the price of gas. As an instance, take the case of the Newcastle Gas Company who are paying the maximum dividend of £4 12s. 6d. per cent. allowed by the sliding scale. But assume that the Company raise the price of gas by 1d. per 1000 cubic feet; in this case the consumers would have to pay £12,000 more for their gas, and the shareholders would lose £2000 owing to the lower dividends paid. Thus it will be seen that the loss to the shareholders is small compared with the loss to the consumers.

Were it not for the sliding-scale, a company would certainly maintain the same rate of dividend, thereby gaining a reputation as a steady dividend-payer, and improving the basis on which new capital could be raised. A company engaged in supplying such a *quasi*-monopoly as gas should be able, by maintaining or steadily increasing their rate of dividend for a number of years, to gradually improve their credit and obtain larger premiums on the occasions of new issues of capital. As an instance, take the case of two maximum-dividend companies—Liverpool and Sheffield—and compare them with two sliding-scale companies—the Gaslight and Coke and South Metropolitan. The two former at present market prices yield £4 5s. and £4 1s. per cent. on investment respectively, while the two latter yield £4 13s. 6d. and £4 8s. 9d.; and it is equally or more apparent if any other sliding-scale companies are taken. Investors in maximum-dividend companies know full well that, however much coal rises in price, their dividends will likely be maintained. They therefore hold their securities. But in the case of the sliding-scale companies, they know that high prices for coal mean reduced dividends. Therefore they realize their stocks, and do not again buy till coal has fallen in price. This accounts for the depreciation in gas stocks during occasions like the present.

It will be remembered that all the London Companies reduced their dividends on the occasion of the last coal boom, which occurred in the year 1900.

It would seem wiser if gas companies working under the sliding-scale were to substantially increase their cash balances during periods of low coal prices, and also refrain from paying the full dividend allowed, but keep a margin (as do most companies) of at least 1d. per 1000 cubic feet for a rise in the price of gas. Proper attention to these two precautions would enable sliding-scale gas companies to maintain absolute regularity in the rate of dividend, and so avoid those worrying variations which frighten investors and destroy the all-important matter of credit. The sliding-scale system is so advantageous to gas companies generally that it seems a pity that its undoubted advantages should be lost by neglect of a proper financial policy.

The ceremony of laying the record stones at the Howden and Derwent Reservoir of the Derwent Valley Water-Works will be performed on the 21st inst. The Bishops of Southwell and Sheffield will take part in the ceremony.

The numerous professional friends of Mr. T. Wilson, of Coatbridge, will be pleased to see that his success is not confined to the making of cheap gas and the provision of big dividends. At the recent 28th annual competition of the National Angling Club's Association on Loch Leven, Mr. Wilson was first (securing the gold medal, with a bonus of £12, and the custody of the Challenge Vase), with a catch of 26 trout, weighing 26 lbs. 1¼ oz. There were 44 competitors, and the competition was the most successful held by the Association; the total capture in nine hours with fly being 582 trout, weighing 434 lbs. 7 oz. Mr. Wilson's was the second heaviest catch ever landed in this contest.

TESTING GAS: PAST, PRESENT, AND FUTURE.

By H. Leicester Greville, F.I.C., F.C.S., &c.

In the history of gas—especially with regard to the development of illuminating power—we have an illustration in practice of the old Arabian Nights story of "Aladdin's Lamp" with some modifications. We have at least the exchange of the old lamp for the new; the transition from the old flat-flame burner, giving an illuminating power of, at the extreme, some two candles per cubic foot, to the modern incandescent, giving (at a moderate estimate) 25 candles per cubic foot. The name of "Welsbach" may thus be substituted for that of "Aladdin."

Turning from this slight digression to a brief record more essentially dealing with the heading of the present article (which embraces a long experience of the whole subject), it is difficult to sufficiently condense my remarks, without possibly trying the patience of my readers, or trespassing too much on your space. At the same time, I hope that the question of the testing of gas is of so much importance to all connected with the gas interests—to the consumer as much as to the manufacturer—that some digression may be justified.

There are two questions over the determination of illuminating power—viz., the standard used for comparison, and the conditions under which the gas should be consumed. From the first records of official gas-testing, I believe that the sperm candle was the standard, and that the gas was consumed at the rate of 5 cubic feet per hour, with variable burners and chimneys. The primeval iron argand and chimney may be abrogated to a long forgotten past; and we can make a fair start on the consideration of the general subject with the advent of Sugg's "London" argand with a 6-inch by 2-inch chimney for common gas, and a No. 7 batswing for cannel gas, as standard burners. I am speaking of both gases, because my first experience of gas-testing was at Arundell Street, Haymarket, W.—the first, I believe, official testing station. Mr. T. W. Keates was the Official Gas Examiner; and he eventually became Superintending Gas Examiner to the Metropolitan Board of Works. When official testing extended, I acted under him for a period of ten years, during which many testing stations came into existence—all under the same conditions. The sperm candle was the standard of light, and the consumption of gas was at a rigid 5 cubic feet per hour in the Sugg "London" argand with a 6-inch by 2-inch chimney.

But a time came in which the (so-called) standard sperm candle fell into contempt. It passed through various vicissitudes. It was nursed carefully by its advocates, and was cursed soundly by its opponents. For some strange reason, everyone seemed to wish to protract its existence. The Gas Referees gave limitations as to the consumption under which certain tests were to be accepted or rejected so as to be registered as official. Instructions were issued as to times of lighting before a test, adjustment of the two candles, as to the curvature of the wick towards the photometer disc, &c., &c.

Then came in another question: What was the standard candle? Officialism, represented by the County Council (at this stage of the history), introduced a new brand of so-called standard candles which—although a legitimate standard candle—gave most disadvantageous results against the gas. I am not quite sure as to my memory over the subject and, unfortunately, have not any records to refer to; but, as far as I can remember the candle for many years in use was of the well-known brand the "Miller," and the fresh introduced was the "Barclay."

Many tests were made, and there were many conflicts between gas companies on the one hand and officialism (presumably representing public interests) on the other. Eventually there was the "Standards of Light Commission" inaugurated, in which I represented the interests of the Commercial Gas Company. I never wish to go through a more painful experience again. All sorts of brands of candles were tested against a reliable standard—viz., the Methven screen, with pure and with carburetted gas. Further tests were made with the one-candle Harcourt pentane standard. The difficulty I had over this is indescribable. Valuable in itself, it was most trying to adjust under conditions of the adjacency of the testing room to a street where heavy traffic was constantly passing. Constant vibrations made the adjustment of a correct height of flame almost impossible.

Of the many standards proposed as a substitute for the candle, the possibilities were at that time: (1) The Harcourt one-candle pentane; (2) the Methven two-candle—plain coal gas or carburetted gas; (3) the Dibdin ten-candle—air carburetted with pentane, with cut-off screen; and (4) the Sugg burner, with the screen cut off to 10 candles, with ordinary gas.

With regard to No. 1, I have always considered that a one-candle standard is undesirable. I am aware that a two-candle pentane standard has been used; but there is great liability of error not only with regard to the standard air gas but on the adjustment of the height of flame and its susceptibility to vibrations. With regard to the Methven standard. It was no doubt at the time reliable, more especially when used with pure coal gas, carburetted by pentane. No. 4 was good at its time with pure coal gas. No. 3 was undoubtedly the best, as independent of the composition of the gas, as the light was derived from simply carburetted air.

Many tests were made over the proposed standards; but the main dispute was simply this, What was the equivalent of a

standard candle in any suggested new unit? The Dibdin ten-candle standard was near acceptance on a modification of the height of the cut-off screen which should represent the average candle; and after a long series of tests it was agreed that the screen should be somewhat lowered. Then came the ten-candle pentane Harcourt standard—still accepted, and upon which it is difficult to suggest any improvement. Criticisms have been made over variations of atmospheric conditions, temperature, pressure, humidity, &c.; but nothing has shown that the validity of this standard is vitiated to any material extent, under fairly normal conditions and with reasonable precautions in its use.

Apart from its accuracy, the Harcourt ten-candle pentane standard has the great advantage of extreme simplicity. It is a "*multum in parvo*;" it is complete in itself. A requisite supply of pentane and a suitable adjustment of the height of the flame, and there is an efficient and reliable standard.

With the introduction of the new standard came the advent of the table photometer, with the abrogation of the rigid 5 cubic feet gas consumption in favour of burning up to a constant 16-candle flame. With regard to the use of the table photometer in place of a well-constructed form of open-bar photometer, there are many *pros* and *cons*; but with regard to the change of procedure, of abolishing the rigid 5 cubic feet consumption, and burning the gas at such a rate as to afford a light of 16 candles, there could be no difference of opinion from unbiassed minds—viz., that it was fairer to the proper development of the light of the gas. It was really a limited recognition of the necessity for adjusting the air supply to the quality of the gas. This change was of advantage to the gas companies, but it was coupled with one other change which was in a sense disadvantageous. Under the old *régime*, when gas was used mainly for lighting purposes, the rule was for official tests to be made during periods of maximum consumption, and Sunday was considered officially a *dies non*. With the new *régime*, the gas could be tested at any time in the day. The gas examiner could make his tests at his own convenience; and the regulation is still in existence. *Primâ facie*, there is no injustice. But not all testing stations are on a leading main, and there is common experience over the deterioration of illuminating power from limited circulation and excessive friction. Therefore, the best test conditions are those of the maximum supply, as the gas company cannot do more than send out gas from their works conforming to legislative requirements.

General gas-testing at the present time is peculiar. Many changes have been made of late years, and modern methods must be regarded as more or less tentative. Sulphur restrictions have been abolished. Tests for ammonia are not made. Illuminating power is ascertained by a burner with an adjustable air supply available for all grades of gas. As far as I can judge, there would be an advantage on all sides of the question. High-class gas does not really suffer, while low-grade gas has every advantage. There can possibly be no better method of testing various grades of illuminating gas than by a regulated air supply—always assuming that an argand with a chimney is regarded as a test-burner. At the same time, it is a crude method of determining the actual value of a gas for lighting purposes. In some places on the Continent, no consumer dreams of using anything but an incandescent burner. Any individual who talked about an argand or a fishtail, batswing, or union-jet, would be regarded as a fool who had not accepted the increased knowledge which should accrue with increasing years.

When I spoke of the present system of gas-testing as "tentative," my expression meant to convey that there was an element of uncertainty which time and experience could alone determine as to what constitutes the best gas for the use of the public, consistently with the gas company making their fair profits. There is now no penalty except for deficiency of illuminating power or pressure. At the same time tests are being made over sulphur compounds, and the value of the gas as to its illuminating efficiency in flat-flame burners. The latter points are very interesting; but are they necessary? It is such a matter of common knowledge that any flat-flame burner is inferior in the development of illuminating power to an argand, and the latter again far more than an incandescent, that it almost looks like "thrashing a dead horse."

With regard to calorific value, the question is different. The time must come at which the valuation of gas must depend on its calorific value—mainly net, and not gross; the distinction being that the former is the only criterion as to the value of gas for ordinary purposes apart from a bath heater.

With regard to sulphur, the only rational excuse for the abrogation of the proportion of sulphur compounds must have been the introduction of the incandescent burner. Consumers who use a flat-flame or an argand burner would suffer the penalty of polluting the atmosphere of their living rooms with the amount of increased sulphur in the gas. Those on the other hand who use the incandescent would not have any increased vitiation or pollution owing to the decreased gas consumption. A simple calculation will show this—

Flat-flame burner with a consumption of 8 cubic feet per hour, and sulphur at 20 grains per 100 cubic feet.
Illuminating power, 14 candles.
Sulphur per hour, 1·6 grains.

Incandescent burner at 2 cubic feet per hour, and sulphur at (say) 50 grains per 100 cubic feet.
Illuminating power, 50 candles.
Sulphur per hour, 1 grain.

In regard to the future of gas testing, I do not profess to be a prophet. I cannot, however, but regard the records of the illuminating power of flat-flame burners, the proportion of sulphur in the gas, &c., as of academic interest simply. A time will come at which it will be recognized that the calorific value of gas is the truest measure of its real value. The gas of the highest calorific value gives the consumer the best value for his money, if he can be made to understand the true aspect of the question. It affords him the best light he can get with an incandescent burner, and the best value he can get for cooking purposes. It also gives the best value to the commercial aspect of the question—viz., the consumer who uses gas for purposes of motive power.

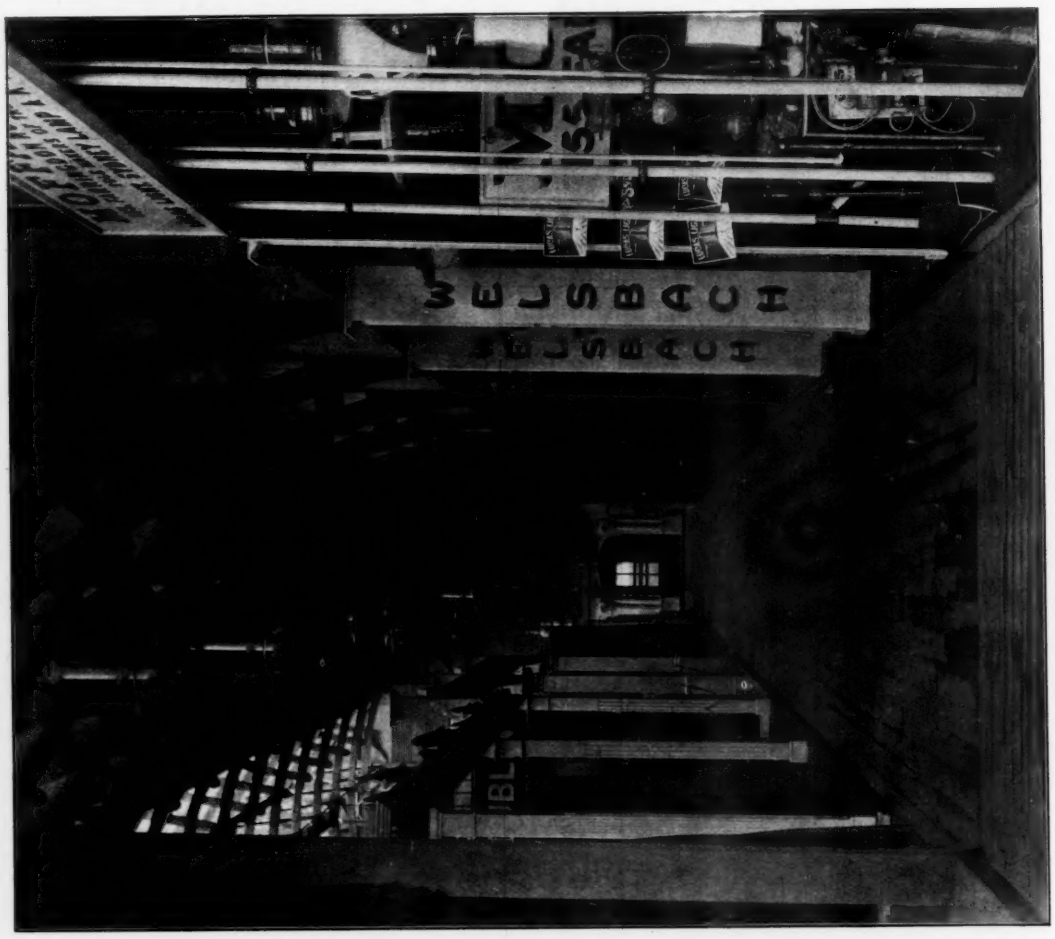
ODORIZING WATER GAS.

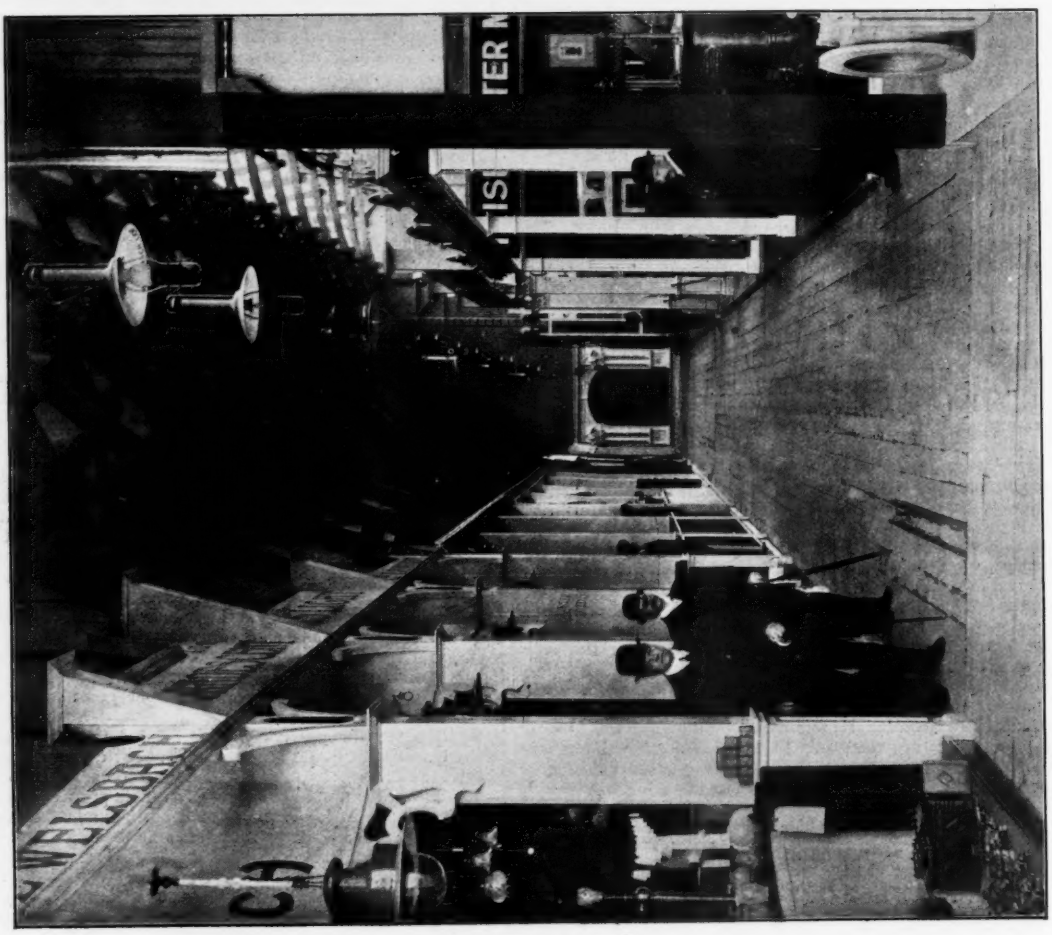
Writing in a recent issue of the "Journal für Gasbeleuchtung," Herr K. Reitmayer, of Vienna, describes the advantages and the defects of the various methods that have been employed in the past for conferring upon simple water gas a penetrating and distinctive odour, so that leakage may be automatically revealed; and, finally, he explains the plan adopted for the same purpose in a process patented by himself in Germany.

We owe the first idea for odorizing water gas to Quaglio, who, in 1880, suggested that, before allowing it to enter the distributing system, the gas should be made to pass over the surface of mercaptan contained in a vessel placed in an enlargement of the pipe—the liquid being fed into the basin from a stoppered funnel through a glass cover so disposed that the process of evaporation could be watched. Afterwards wicks were slung from the exit of the funnel across a space in the pipe; their lower ends dipping in a basin as before. A defect was soon apparent, for the odour of mercaptan was liable to be confused with the odours evolved in cooking operations, and leaks in a kitchen were consequently prone to be ignored. In 1893, Strache proposed using carbylamine instead—a liquid possessed of a more powerful and characteristic odour. Again a defect appeared; for gas thoroughly scented with carbylamine occasionally lost its odour, and accidents occurred. Investigation proved that the carbylamine was decomposed by sulphuretted hydrogen into an odourless body; and since complete absence of sulphuretted hydrogen cannot be ensured, the liquid was shown to be unsuitable.

Further study of the question, too, indicated that the proper odoriferous vapour for addition to simple water gas was one that should give it an odour closely resembling that which members of the non-technical public already mentally associate with "gas," not something having a totally different and previously unknown scent. Working on these lines, Tschany made the next useful suggestion in 1898. He proposed to employ as the perfume the vaporized hydrocarbons that condense into a liquid condition when oil gas is compressed for train lighting. The liquid is cheap and quite efficient; but as long as the original plan of allowing automatic evaporation from an open receptacle placed at the inlet of the mains was retained, difficulties still cropped up. For example, during the nights when the consumption fell, the gas passing over the liquid took up so much vapour as to be practically "carburetted" with it, and the incandescent burners smoked.

The process patented by Reitmayer is stated to avoid all these defects. The vapour is introduced into the gas when and as it is made, so that it is delivered to the holder duly scented. The plant comprises a water-pump fed with the water which is afterwards used in the scrubber. The pump aspirates a current of air through a meter and a vaporizer; the quantity of air being that needed for the revivification *in situ* of the purifying material. The pump itself is composed of as many descending pipes as may be required to aspirate the proper quantity of air—*i.e.*, 2 per cent. of the gas passing through the purifier. The air-pipe entering the odorizer is fitted with a bye-pass having a cock on it, so that a certain proportion of air may be drawn in without odour. By this device the powerfulness of the odour of the finished gas can be regulated, and adjustments can be made to suit variations in the volatility of different batches of liquid. The evaporating basin is supplied from a graduated glass vessel, fed from a larger store. In order to prevent accidental production of unscented gas, the evaporating vessel is large enough to hold liquid sufficient for several days. The apparatus is brought into action simply by opening the cock on the water-supply pipe, which is done at the moment when the "run" commences—the one operation, as already explained, adding odour to the gas as it is produced, feeding the scrubber where it is washed with fresh water, and also supplying to the purifier the air needed to revivify the charge. The quantity of liquid volatilized is about 0·3 litre per 100 cubic metres. The whole process is claimed to exhibit two other important but incidental advantages over its predecessors. In the first place, according to Benoid's experiments, volatilization of a liquid in a current of gas proceeds more smoothly and is less dependent upon temperature when the gas is aspirated than when it is forced through the carburettor. In the second place, Reitmayer's system renders the water gas recognizable by its odour as it issues from the generator; therefore leakage in any subsequent item of the plant becomes more obvious than when the gas is only scented as it leaves the works, and gassing of the men is prevented.





THE GAS PAVILION AT THE IRISH INTERNATIONAL EXHIBITION, DUBLIN.

THE GAS PAVILION AT THE IRISH INTERNATIONAL EXHIBITION.

We give above a view showing the exterior of the Gas Pavilion at the Irish International Exhibition, Dublin; and on the opposite page are two views of the interior. For these, as also for the photographs which appeared in the "Journal" last week, pp. 642-645, we have to thank Mr. Francis T. Cotton, the Secretary and Manager of the Alliance and Dublin Consumers' Gas Company.

It may be mentioned in connection with these views that the photographs reproduced last week were taken by Messrs. Robinson and Son, and those given to-day by the Gas Company's own staff.

THE PATENT OFFICE IN 1906.

It seems to be quite clear from the twenty-fourth report of Mr. C. N. Dalton, the Comptroller-General of Patents, Designs, and Trade Marks, that no discouragement has resulted to inventors from the investigation (for the purpose of ascertaining whether inventions sought to be patented have been entirely or partially claimed or described in specifications of prior date) which the Patent Office are required to carry out under the Act of 1902. In fact, as is pointed out in the report, the new rule has been accompanied by an immediate and very substantial increase in the number of complete specifications filed. The figures for the past four years are as follows: 1903—applications, 28,854; complete specifications filed, 15,831. 1904—29,702 and 15,925. 1905—27,577 and 18,806. 1906—30,002 and 18,228. The "official search" came into operation Jan. 1, 1905; and though it is admitted that a considerable part of the increase in that year over 1904 was attributable to the more expeditious filing of the specifications necessitated by the shortening of the time allowed for the purpose from nine to six months, the Comptroller says it is difficult to account for the high figure of 1906 on any other assumption than that inventors generally have appreciated the benefits which the official search has conferred on them.

Some definite idea of the results of the new investigation method can now be gathered, as the final statistics in regard to 1905 are rendered available by effluxion of time. As already stated, there were 27,577 applications in the year; and in respect of these, 16,746 complete specifications were filed, and 15,369 were accepted. Anticipation was reported by the examiners wholly in 1308 cases (8·5 per cent.), and partly in 8238 cases (53·6 per cent.); so that there was found to be no anticipation in 5823 of the instances (37·9 per cent.). Of these 9546 cases of anticipation, 7725, or 81 per cent., were amended by agreement in such a way as to meet the anticipation. In 1060 instances where the necessary amendment was not otherwise made, hearings took place, and the specifications were amended as the result of the decisions (reference by name or number to a prior patent or patents being inserted in 556 instances). Thus, altogether, of the 15,369 complete specifications accepted, no less than 8785 were amended—in consequence of the official investigation—the effect in each instance being "to cause the specification to define more clearly and closely the nature of the invention and the scope of the patent to be granted, having regard to the condition of the art as disclosed by the prior specification or specifications found by the examiner during his investigation." In connection with the same matter, another noticeable fact brought out by the report is that in the ten years prior to 1905 the average annual number of applications which became void owing to the fact that complete specifications were not accepted within the statutory period was 196; whereas in 1905 no less than 1374 applications became void for the same reason. The Comptroller says that presumably the voiding of this additional number of applications was mainly due to the official investigation; and it seems to him to be eminently satisfactory, and a great advantage to prospective patentees and to the public generally, that the new system has resulted in the non-granting of such a large number of patents which would *prima facie* have been invalid.

As indicated above, invention was one of the things for which a "brisk time" in 1906 has to be recorded. The 30,002 applications which were received were an increase of 8·8 per cent. on 1905; and there was even a slight addition to the number sent in by women inventors—though the proportion which the 600 applications received in this way in 1906 bear to the total number affords plenty of material for argument with regard to a question which has long proved highly controversial in various quarters. While there was little change last year in the number of applications received from Scotland and Ireland, those from persons resident in England and Wales reached 18,547, as against 17,448 in 1905, which was an increase of 6·3 per cent., and the highest figure touched since 1897. One interesting feature of the report is the proof it furnishes that in 1906, for the first time, more applications were received from Germany than from the United States; the numbers being respectively 3257 and 3010. In the matter of patents granted, however, the United States are still ahead with 2595; the figure for Germany being 2091, while France is a bad third with 769. Then come Austria-Hungary 257, Switzerland 190, Canada 145, Belgium 137, Italy 111, and Sweden 105. Of the total number of applications received in 1905, patents were sealed in the cases of 14,816, or 53·7 per cent.; and of patents sealed upon applications made in 1893, no more than 542, or 4·6 per cent., were maintained for the full fourteen years.

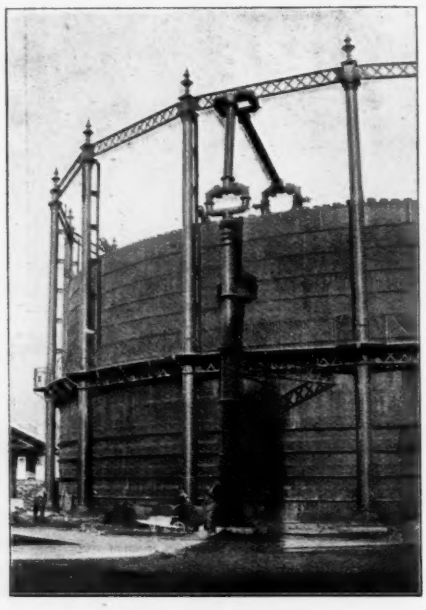
With regard to the subject-matter of patent applications, motor vehicles were responsible for a large number in the year under review; while in various other directions inventors turned their attention to solving problems which had presented themselves in a general manner in connection with current events. Inverted incandescent gas-burners, and the adaptation of ordinary upright fittings for use therewith, were the object of numerous applications; while metallic filament electric lamps, and reinforced concrete building also make a good showing. Inventions are divided by the Patent Office into 146 classes; and the number of published complete specifications in the classes in which "Journal" readers are more specially interested for 1904 and 1905 are as follows, the figures for 1904 being placed in parentheses: Air and gas engines, 459 (511); cooking, &c., 142 (216); gas distribution, 52 (62); gas manufacture, 190 (179); heating, 254 (313); lamps, &c., 474 (474).

NICE AND ITS GAS-WORKS.

[Communicated.]

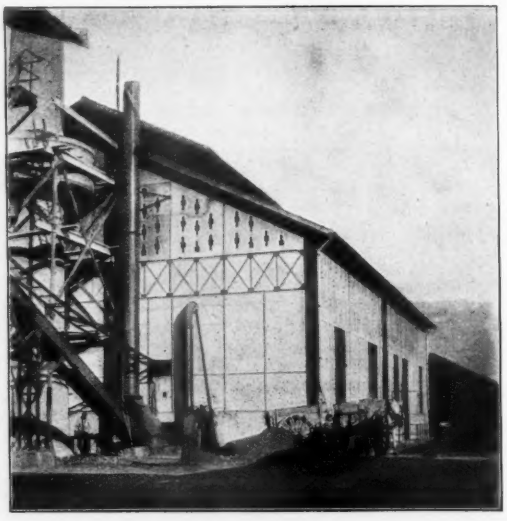
The gas-works at Nice were recently visited by the writer, and it may be of interest to readers of the "Journal" if mention be made of a few other details of the works in addition to the new retort-house and coke-plant described on April 30.

The method of delivering the coal, and of removing much of the coke in waggons on the electric tramway route, is novel as far as this country is concerned; but it is undoubtedly a good method for a works situated, as is that at Nice, at some distance from either railroad or waterway. Many industrial concerns in this country would benefit in no small degree if the electric tramways could be adopted—as are many in France—for goods as well as for passenger traffic. One detail in connection with the hydraulic mains in the new retort-house is worthy of mention—namely, an adjustable tar overflow, so arranged that the tar may be seen overflowing. This method is infinitely preferable to the closed boxes usually adopted; for it can be known at a glance whether or not a box is working properly.



The Inlet to One of the Gasholders.

In the new part of the works may be seen a row of three exhausters driven by a single gas-engine; the power being transmitted by belts running on differential pulleys. The gas-engine, which is duplicated, will shortly be connected to three further exhausters, all of which will be driven in the same manner as those already installed. Each exhauster is fitted with a bye-pass, so as to maintain a constant load for the gas-engine. This method of exhauster-driving by gas-engines has been adopted from reasons of economy; and in this particular works gas-engine and steam-engine driving have been used side by side, with the result that the latter method has been discarded.



Part of the New Retort-House.
(The Walls of the Building are constructed of Concrete and Steel.)

New Installation of Exhausters to be Shortly put in Use.

The purifier grids in use at the Nice works are made of thin laths of wood, fitted together in basket-work fashion and stiffened with iron rods. It is claimed that these grids—besides being cheaper and more durable than the ordinary wooden grid—have a tendency to give the gas a lateral and spreading, rather than a purely vertical, travel; and any increased efficiency is probably due to this cause.

The Nice Gas-Works are quite the largest on the French Reviera and, as will be concluded from the description of the new retort-house and coke plant in the "Journal" for April 30, they are quite up to date in every particular. The condensing, washing, and scrubbing appliances are also arranged on the most modern and approved methods.

EXPERIENCES WITH LARGE GAS-ENGINES.

At a Meeting of the Society of Engineers on Monday evening last week, at the Royal United Service Institution, a paper was read on "Working Experiences with Large Gas-Engines," by Mr. Cecil A. St. George Moore, B.A.

The author commenced by comparing the various forms of gas-engines built in Great Britain with those built on the Continent, and enumerated the characteristics of the different types of engine as designed by various manufacturers with regard to number and arrangement of cylinders, single and double acting engines, and other points of design. After pointing out the advantages or otherwise of positive scavenging, and which is still an open question, the author considered the various methods used for governing, and remarked that in Continental practice this point had received very careful attention.

The author next dealt with the relative advantages of the two-stroke and four-stroke cycles; the Körting and the Oechelhäuser engines being taken as the most prominent examples of the former type. He considered that the thermal and mechanical efficiencies of the Körting type of engine were lower than in the case of the four-cycle type; and he gave results of tests bearing out this conclusion.

He then gave some details as to the design of the piston and cylinder of the Körting engine, and mentioned several defects in these parts which had given trouble; and he described modifications in design that had been adopted to overcome the defects. After giving some details as to the actual wear of cylinders in practice, the author proceeded to discuss the question of the correct method of supporting the piston, and referred to the difficulty of keeping the rods quite straight if the piston was supported from the guides.

The next point considered was metallic packing. After noting the essential points of a satisfactory packing, the author described a form of packing that he had found to work well in practice. Reference was then made to the theory of stratification of the working mixture as applied in the Körting engine, and an account was given of some curious effects noted on changing the position of the point of ignition in the cylinder. The author then treated, at some length, the question of pre-ignition in large engines, and referred to some of its probable causes.

After noticing the utilization of the waste heat of the exhaust, the author concluded by considering the properties of producer gas and its suitability for use in large engines. He laid great stress on the necessity for a thorough cleaning of the gas, and mentioned the effects of tarry gas when supplied to an engine. He arrived at the conclusion that a percentage of about 27 of hydrogen in producer gas was not too great for its satisfactory use in large engines.

A NEW HIGH-POWER GAS-LAMP.

By Dr. C. Richard Böhm, of Berlin.

The great progress in artificial illumination during the last decade has been accompanied not only by greater efficiency and more convenient manipulation, but also by greater intensity of light. Thus so eager a desire for light has arisen as was never before dreamt of. Since the introduction of the electric arc lamp, every effort has been made to increase the illumination derived from oil and gas, in order to approach, if possible, the great intensity of the electric arc lamp.

With the discoveries of Auer von Welsbach, gas lighting entered upon a new stage in its development—since the well-known incandescent burners in conjunction with first-rate mantles produce 100 to 120 Hefner candles, and in efficiency have a decided advantage over even the newest metallic filament electric lamps. It is, however, more difficult for the gas engineer to compete with the electric arc lamp. The "Lucas" lamp, which, in the simplest manner, produced with gas a light of 500 Hefner candles, could certainly be compared with the earlier electric arc lamps. But it was bound to succumb before the powerful light-centres of the flame arc lamps of 1000 candles, such as are now to be seen in all great cities.

The principle of the Lucas lamp was the supplying of a greater quantity of air to the burning gases by the draught produced by a long chimney. In the ordinary incandescent burner, the supply of air is deficient. The highest illuminating power of the incandescent mantle is produced when the temperature of combustion of the gases is highest. This effect is, however, only attained when the combustion is perfect, for which a six-fold quantity of air is necessary. Since in an ordinary bunsen burner, with normal gas pressure, the flame is only supplied with about half the amount of air necessary for complete combustion, it follows that air must be drawn by the flame from the surrounding atmosphere. This lateral withdrawal of air which takes place throughout the porous fabric of the mantle, causes a certain lowering of temperature; so that the gas consumed in the burner does not produce the heating effect which can be brought about with a more perfect mixture of gas and air. In the Lucas lamp, the required quantity of air with an increasing quantity of gas could not be further increased by the action of the chimney, since it was not feasible to further increase its length when it was already inconveniently long in the 500-candle power lamp.

The various systems of compressed gas lighting, on the other hand, fulfilled the above requirements, since the higher velocity of the gas produced by pressure had the effect of leading the necessary quantity of air into the burner. Whether the gas in the pipe, or the air, or the mixture of gas and air is compressed, the same effect results, since they all lead to a more perfect combustion and greater efficiency.

The compressed gas systems, in whichever manner they operate, are always associated with a somewhat large apparatus for the purpose of carrying out the work of compression. This dependence of compressed gas lighting and motor power, compressors, special plant, and careful attention, formed in practice a rather important feature against their general introduction.

A new high-power lamp which when fixed in an ordinary gas installation produces of its own accord the desired higher pressure and intimate mixture of the right quantities of gas and air for the combustion without subsidiary apparatus, should be a subject of great interest.

In 1895-6, Denayrouze sought to bring about a better mixture of gas and air by arranging in the mixing-tube of the incandescent burner a small fan driven by means of a small electric motor. In this way, he was able to create a greater efficiency for improved lighting effects, but was not able to produce the intense light-centres such as are required to-day.

The inventor of the original Lucas lamp has now succeeded in constructing a new high-power lamp depending upon other principles. While Denayrouze obtained the power necessary for his motor from a special source of electricity, Lucas has arranged a thermopile in the lamp itself, which is heated by the waste gases, and thus produces free of cost the electric current for driving the fan. The thermopile is connected by leading wires with a small motor in the lower part of the lamp, which on its part is coupled up with a fan.

Fig. 1 shows the new lamp ready for use; fig. 2 shows the lamp with the glass globe lowered; and fig. 3 is a vertical section through the important lower part of the lamp.

By means of the pipes which are bent at the top, and enamelled white below, and which terminate in the roses D, the gas is led into two mixing-tubes. The armature A of the small electromotor arranged between the poles of two steel magnets runs with a vertical axis on a point in a brass case filled with oil, in order to avoid friction as much as possible. On the armature a fan provided with six wings F is screwed. The fan sucks up air from below; mixes it with the gas passing out from the roses D; and forces the mixture of gas and air through the mixing-tubes and mixing-chamber into the burner-head N. The hot products of combustion, in rising, heat the inner junctions of the thermopile A, and thereby produce the electric current. The current is led to the two brushes enclosed in the chamber B, which lie by virtue of their own weight on the commutator of the armature.

Thermopiles have been known for a considerable time; nevertheless it was important in this case to choose a construction which might be as convenient as possible and, above all things, durable. There was no need to consider the cost of heating it, for the waste gases themselves provided a source of heat. Lucas uses two metallic alloys for making his thermopile. One of these consists of copper and aluminium; the other of copper and nickel. These alloys, which are capable of withstanding heat to a high degree, are employed in the form of metal strips, which are soldered hard at the heated end and soft at the cool end. The thermopile is arranged in the form of a disc, and can be replaced in a few moments. Just as ingenious are the small motor and fan; so that they are not likely to get out of order even after long usage.

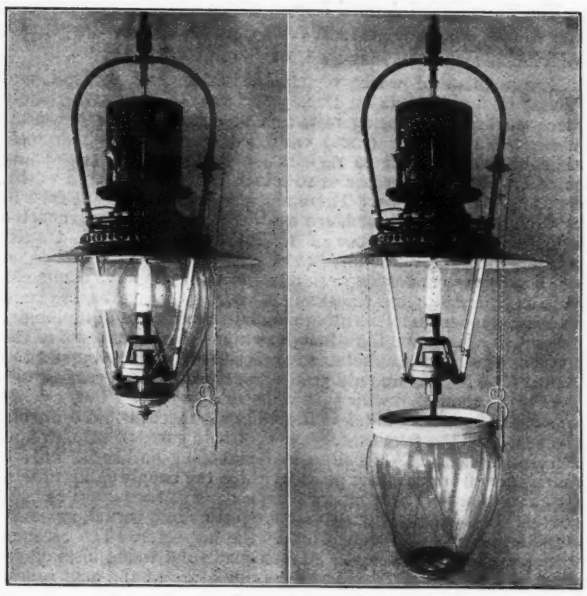


Fig. 1. Fig. 2.

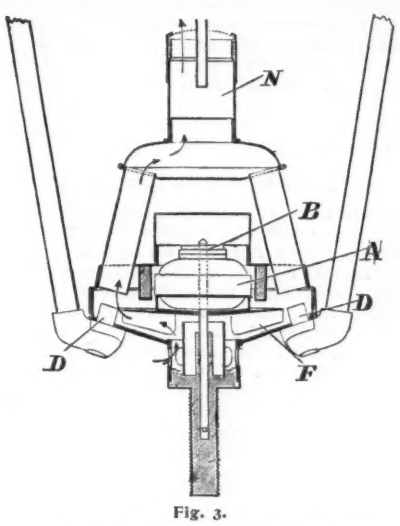


Fig. 3.

The Lucas New High-Power Gas-Lamp.

On starting the lamp, it burns at first (the pressure of the gas being, of course, only normal) with a feeble flame of little illuminating power. Presently the hot products of combustion rising in the chimney heat up the inner junctions of the thermopile. The electric current is thus generated, so that the electric motor presently commences to rotate the fan at a high speed. After only about half-a-minute, it already attains a speed of some 2000 revolutions per minute, and the lamp then emits a light of 1100 to 1200 Hefner candles—consuming about 900 litres of gas per hour.

Professor Wedding has subjected this high-power lamp to a searching examination, and found that it behaves well even in extreme cases, and as a lamp for intense illuminating purposes is far superior to the older compressed-gas lamps. It possesses, moreover, the great advantage that it works without the aid of extraneous apparatus, and can be attached to any ordinary gas installation and set into action at once.

The electric motor after 1460 hours was still in excellent order, and the oiling only needed to be renewed after 500 or 600 hours.

The incandescent mantle, as is the case with the older systems in use, lasted for about 70 hours, and the mantle holder for about 300 hours. The regulation of the lamp, and the manipulation of the various parts, is quite simple.

There can be no doubt that this new high-power lamp is a great acquisition for gas-lighting purposes. The light emitted, although of great power, is pleasant and uniform. The utility of the lamp in practice has been put to the proof by a year of uninterrupted observation.

ALKALI WORKS CHIEF INSPECTOR'S REPORT.

The Forty-Third Annual Report of the Chief Inspector under the Alkali Works Regulation Acts (Mr. R. Forbes Carpenter), which deals with the year 1906, was issued last week.

The number of works registered in England, Ireland, and Wales under the Acts on Dec. 31 was 1078. Of these, 72 only were works decomposing salt, and so scheduled alkali works; while the remainder (1006) carried on processes which were scheduled or subject to registration under the Acts. These numbers show an increase of 10 scheduled and registered works, as compared with 1905. There are also 143 works registered in Scotland—which, as usual, are dealt with in a separate report—bringing the total number of works registered in the United Kingdom to 1221. The number of separate scheduled and registered processes under inspection last year was 1500, as compared with 1481 in 1905; the chief increase during the year having been in processes for manufacturing sulphate or muriate of ammonia. Not much change, on the whole, has taken place in respect of the number of other manufactures scheduled or registered under the Acts. The Inspectors paid 5166 visits to works, and carried out 5515 tests, compared with 5315 visits and 5137 tests in 1905. It was found necessary to take proceedings in three instances during the year. In the first case, escapes of acid gases of sulphur and nitrogen in excess of Act limits were found being discharged into the atmosphere from chamber plant in which the supply of liquid acid required to seal the chambers from escape of their gaseous acid contents had been withdrawn for a considerable period, notwithstanding serious warnings given by the inspector. The escapes were protracted; the liquid acid as made not being allowed to accumulate to stop the continuous discharge of the acid gases, but being withdrawn rapidly, for the exigencies of sale. In the two other cases, serious escapes of noxious and offensive gases took place in the manufacture of sulphate of ammonia; there being, in both, neglect of very obvious and necessary precautions. In these instances it was admitted that the best practicable means for prevention of escape were not being employed. For all three cases, the full penalties were paid; the offences being admitted, and not contested. In the case of a works found on visits by the inspectors to be carrying on a scheduled process of manufacture without having applied for registration under the Acts, back registration fees were accepted by the Board in lieu of the penalties incurred.

Enlargement of Inspection.

The Alkali, &c., Works Regulation Act, 1906, which came into operation on Jan. 1 last, and which entirely repeals the Alkali, &c., Works Regulation Acts of 1881 and 1892, and the Local Government Board's Provisional Order Confirmation (Salt Works) Act, 1884, brings within its provisions several works which were not within those Acts, and difiers in various particulars from them. Mr. Carpenter reproduces a memorandum issued by the Local Government Board last December, for the purpose of showing the main points of difference. Among the new works included, the former exemptions with regard to sulphuric acid works are removed; and the definition now clearly applies to works for the concentration and distillation of sulphuric acid. The definition "gas-liquor works" now applies to works in which ammoniacal liquor is desulphurized by the application of heat in any process connected with the purification of gas. "Alkali waste works" will include all works in which alkali waste or the drainage therefrom is subjected to any chemical process for the recovery of sulphur, or the utilization of any constituent of such waste or drainage. "Tar-works" will include works where coal tar is distilled or heated in any manufacturing process. Section 9 (7) requires that written notice of any change in the ownership of a works, or in other particulars stated in the register, shall within one month be sent to the Local Government Board. Formerly such notice had to be sent to an inspector. Under section 9 (8) the penalty for carrying on a works without registration will be a fine not exceeding £50, instead of a fine not exceeding £5 for every day during contravention. Section 17 (2) has removed the limitation of three months within which it was necessary that proceedings for the recovery of a fine for non-registration should be commenced. Under the previous Acts, an inspector had power to enter and inspect any works to which they applied; but sometimes questions arose as to whether in a particular case the Acts applied or not. Under section 12 (1) of the new Act, the powers of an inspector as regards entry and inspection may be exercised in respect of any works to which, in the opinion of the Local Government Board, any of the provisions of the Act applies; and section 12 (4) enables proceedings for the recovery of a fine for not affording facilities to an inspector, or for obstructing him in the execution of his duties, to be taken under the Summary Jurisdiction Acts. Under section 12 (2), the plan of part of the works which the owner of any work to which, in the opinion of the Board, the Act applies must, on the demand of the Chief Inspector, furnish to him is now limited to a sketch plan. Section 27 specifies certain gases and fumes as included in the expression "noxious or offensive gas." This section also defines the expression "best practicable means" (where used with respect to the prevention of the escape of noxious and offensive gases) as having reference, not only to the provision and the efficient maintenance of appliances adequate for preventing such escape, but also to the manner in which such appliances are used, and to the proper supervision by the owner of any operation in which such gases are evolved. All sulphuric acid works are now subject to the provisions of section 7 as to the adoption of the best practicable means for preventing the escape of noxious or offensive gases by the exit flue of any apparatus used in any process carried on in the work, and for preventing the discharge, whether directly or indirectly, of such gases into the atmosphere, and for rendering such gases where discharged harmless and inoffensive. But, in the case of a works in which the manufacture of sulphuric acid is carried on by the lead chamber process, section 6 (1) requires specifically that the total acidity of the acid gases of sulphur, or of sulphur and nitrogen, which are evolved in the process of the manufacture, shall not exceed what is equivalent to 4 grains of sulphuric anhydride in each cubic foot of residual gases after completion of the process, and before admixture with air, smoke, or other gases. In the case, however, of works for the concentration or distillation of sulphuric acid, the total acidity of the gases finally discharged into the atmosphere (including acid gases arising from the combustion of coal) is not to exceed what is equivalent to 1½ grains of sulphuric anhydride in each cubic foot, except that by virtue of section 26 this limit is extended for a period of three years after the commencement of the Act to 2 grains of sulphuric anhydride in the case of works where the overheat pan process is used for the concentration of sulphuric acid.

The Emissions of Works' Chimneys.

Referring to alkali waste works, Mr. Carpenter says that plant has been kept in full operation during the year; and at its close there was no slackening of activity. The acidity of the chimneys to which are draughted the residual gases of the Chance-Claus process after combustion of their sulphur contents, so that all escaping sulphur is discharged into the atmosphere as sulphurous acid, still shows a figure in several districts that cannot be regarded as satisfactory. In the district where the largest works of the type named is situated, and where the plant and supervision of the working of the process are both of an extremely perfect character, the figure of acidity in the chimney gases shows a decrease as compared with the previous year, though still an increase over that of 1904. The experimental work on the reactions of the Claus kiln has been prosecuted almost uninterruptedly throughout the year; but he is not free to speak in detail as to results obtained. Within the last few months, however, the experiments have taken a form which seems to justify hopes of a promising issue as not far distant. It is, Mr. Carpenter adds, necessary to be cautious in indulging expectations, since during the year experience has shown that results from a process watched steadily over twelve months may be wrongly interpreted, and so success in repetition be frustrated, from attributing results to wrong causes.

Purification in Sulphate of Ammonia Manufacture.

Dealing with the subject of sulphate and muriate of ammonia and gas-liquor works, Mr. Carpenter remarks that this important class of works shows a notable increase in number over the figures for 1905. The number of processes carried on in these works forms by far the largest contribution to the total of 1500—the sum of all the separate processes—accounting for 536, or exceeding 35 per cent., of the total under the purview of the Acts of 1881 and 1892. Regarding the progress made in methods for rendering the escapes from these works harmless and inoffensive when discharged, mention is made of the Radcliffe process for the removal of sulphocyanides from the spent liquors so as to counteract objection to their reception into the sewers of local authorities adopting bacterial treatment of sewage; and also of the work of Dr. Gilbert Fowler, in Manchester, which has been in progress experimentally for a considerable period, during which time much experience has been gained. Continuing, Mr. Carpenter says the Claus process of sulphur recovery has somewhat extended. It seems well adapted for coke-oven recovery plants, as the operations there are continuous, thus favouring steadiness of reaction in the kiln. Moreover, the percentage of sulphuretted hydrogen in the foul gases is usually high in this class of works. As regards the method of purification by oxide of iron, the experience of the year has been mostly favourable to the application of this in heap purifiers, as described last year. If these are exposed freely to the weather and the action of strong winds, the heap needs to be of considerable mass to withstand the "blowing through" effects of the wind, if in force, which is apt to cause rapid fouling of the oxide on the lee side. In one works, where in the disposal of the effluent no difficulties arise if it comes in contact with sewage on bacterial beds, a successful attempt has been made to reduce the volatile cyanides in the ammoniacal liquors (coke oven) before distillation, by the addition of polysulphide of calcium in solution to the liquors entering the heater preceding the still. Careful

experiments were first of all made, upon which the method finally adopted was based. From the record of tests made, the percentage of hydrocyanic acid in the saturator gases entering the Claus kiln where they are dealt with for recovery of sulphur has been regularly reduced below 1 per cent. of hydrocyanic acid by volume calculated on the dry gases since the adjustment of the relative volumes of polysulphide solution to ammoniacal liquor has been made. Other processes, which are based on the removal of cyanide as an insoluble ferrocyanide, and so would be applicable where spent liquors have to meet with other effluents in district sewers, have been much discussed; and the question of adopting one or other method, as a trial, has been under serious consideration by more than one registered owner of coke-oven works.

Ferrocyanides in Sulphate Saturators.

Mr. Carpenter refers as follows to the subject of the conditions affecting the formation of ferrocyanides in sulphate of ammonia saturators ("blue salt").

The analytical work set out in Mr. Linder's memorandum last year, as well as the conclusions drawn from its consideration, have met with high appreciation from technologists and manufacturers, as throwing much needed light on an obscure subject. While by no means desiring to exclude other conditions as contributory, it may be stated with increasing certitude, as the result of another year's experience, that, given an acid in the saturator of sufficient iron content, the determining cause of precipitation of the insoluble ammonium ferrous ferrocyanide among the separating crystals of ammonium sulphate is local alkalinity occurring at some part of the saturator—especially in the neighbourhood of the pipe distributing the vapours containing volatile ammonia salts, ammonium cyanide being one of these.

To restate briefly the conclusions of the memorandum, the first stage consists in the formation in the saturator of ammonium ferrocyanide. To reach this stage, hydrated sulphide or oxide of iron in suspension must first separate from the mixture in the separator. For this to happen the liquors must be neutral or alkaline. If the temperature of the saturator be low, conditions are favourable for increased solubility of hydrocyanic acid. Once this is fixed as ferrocyanide, no amount of subsequent boil of the saturator liquors, under ordinary process conditions, even when again rendered acid, will make it volatile. In the second stage, with access of ferrous salts in acid solution, ammonium ferrous ferrocyanide, a white precipitate insoluble in acid, results. On being fished from the saturator with the crystals of ammonium sulphate, its appearance, being white, is not noticed. Continued exposure to the air, however, induces oxidation of the ferrous salt to ferric ferrocyanide, or Prussian blue.

In the memorandum, therefore, local alkalinity, coupled with low saturator temperature, were dwelt on as conditions most favouring the formation of this objectionable product. Priming of the still would induce both these conditions; but they can exist without priming having occurred. Evidence of how far the mischief has proceeded can at any time be obtained by adding to a sample of the saturator liquor (which should, of course, possess a decidedly acid reaction) a few drops of hydrogen peroxide, when, if ferrous ferrocyanide be present, blue coloration will result. In one works known to me, when the shifts of attendants change, the oxidation test in another form is regularly applied by the incoming attendant to satisfy himself he is taking over the plant in good condition, since the salt fished from the saturators may be formed at a period later than the body that ultimately leads to its discoloration.

It is needless, in this recapitulation, to more than indicate the influence of ill-designed or defective plant in promoting the occurrence of these unfavourable conditions in the saturator. Sufficient examples were mentioned in the memorandum to direct the attention of technologists to the importance of observing certain canons of construction to which in the past too little weight has been attached.

I have received from the manager of one works the record of some extremely interesting experiments conducted both in the laboratory and in the works on the plant under his charge. As regards the latter class, no oxidizing tests appear to have been applied at the time to the saturator liquors to ascertain the absence or presence of ferrous ferrocyanide. Had such tests been made, the conclusions drawn would have received more assured acceptance. As regards the former class, we were unable in the laboratory to repeat some of the results he obtained. The importance of maintaining a good boil in the saturator is fully recognized; but the individual experience of the author of the notes does not lead him to recognize local alkalinity as a disposing cause of the formation of blue salt in the saturators he works. The experimental results indicated how much thought had been given to varying conditions. It is, therefore, to be hoped that they may soon be published, so as to be available for others engaged in fighting with similar difficulties elsewhere.

Sulphate Production from Various Sources.

Mr. Carpenter gives in the next section of the report his customary statistics (for which he acknowledges his indebtedness to manufacturers) in regard to the production of sulphate of ammonia in the United Kingdom. The figures—which, he remarks, this year present features of considerable interest—are as follows.

—	1906.	1905.	1904.
Gas-works	157,160	155,957	150,208
Iron-works	21,284	20,376	19,568
Shale-works	48,534	46,344	42,486
Coke-oven works	43,677	30,732	20,848
Producer-gas and carbonizing works (bone and coal).	18,736	15,705	12,880
Total	289,391	269,114	245,990

The gas industry, he points out, still remains the most important contributor. The advance of last year has been a little more than maintained; but the increase all round has been very small. Iron-works recovering ammonia from blast-furnace gases are almost exclusively confined to Scotland, as only in special districts is coal possessed of sufficient hardness to stand in the blast-furnace without crushing. The English works are confined to Staffordshire. The increase has been quite substantial, plant having been fully employed. The production from shale distillation, entirely confined to Scotland, also shows notable increase. The most remarkable development in England and Wales concerns coke-oven works. As regards the last subhead, the increase arises entirely from the operation of producer-gas plants, the number of which continues to be added to. In contributing to this increase, Scotland has taken much the greatest share.

Analytical Work and Cyanogen Compounds.

On the subject of the constitution of ammoniacal liquors, Mr. Carpenter says:

The features that have claimed attention this year in the laboratory investigations carried on concern the amount and distribution of cyanogen compounds and their estimation both in the liquors and in their distillation products, especially in coke-oven liquors, which differ materially from those produced and worked up in gas-works residuals plant. To rehearse briefly, in normal conditions cyanogen, combined as ammonium thiocyanate, is the product of secondary reactions proceeding in the liquors themselves. With access of air, oxidation of ammonium sulphide results in the formation of some ammonium polysulphide, which immediately parts with its sulphur to the ammonium cyanide, which latter, as shown by the examination of virgin liquors, is one of the simple products of condensation. The greater the amount of storage for the liquor, the longer are the opportunities for operation of the secondary oxidation reactions. In coke-oven works, the storage room being usually restricted, the operations of secondary reactions in the liquors are restricted in like manner; so that, though in such liquors the proportion of total cyanogen to ammonia may be less than in liquors from gas-works sources, the mode of its combination is markedly different—cyanogen volatile as hydrocyanic acid far exceeding, as a rule, that fixed as thiocyanate or ferrocyanide, while the reverse obtained in samples of liquors examined from gas-works sources.

Some examination, moreover, has been made of the cyanogen contents of the liquors proceeding from condensation of the steam and fuel gases from the sulphate of ammonia saturators after extraction of the ammonia. Owing to the high proportionate solubility of hydrocyanic acid, these liquors (described in the trade very appropriately as "devil liquors") were found, when drawn from the cold end of the condensing apparatus, to contain this substance in very marked amount; so that the precautions needed in handling such liquors, or transferring them from one receptacle to another, should be clearly set before the workmen employed by those responsible for the manufacture. I have come across one instance where such cold liquor contained regularly from 0·7 to 1 per cent. of this poisonous compound.

The report bears testimony to the value of Mr. Linder's work (which is presented in a special memorandum) in the perfection of analytical methods and their application to the often difficult conditions found existing in the works.

Pyrometry and Carbonization.

In an important section dealing with carbonization temperatures in coke-ovens and gas-retorts, Mr. Carpenter says the electrical pyrometer, in its various forms, is becoming an almost indispensable instrument in many industries where high temperatures have to be regularly maintained. By using the recording form of the instrument, a graphic record can be presented of temperature conditions at any chosen spot. This becomes an invaluable aid in the study of temperature changes in the interior of coke-ovens and of gas-retorts, by which the progress of carbonization can be traced from start to finish, and the maximum temperatures to which the gaseous products are exposed in their passage from the retorts or ovens can be ascertained with considerable measure of exactness. Through the courtesy of the owner and managers of the Bridgewater Collieries, he is able to reproduce a graphic record from one of the coke-ovens at Brackley Collieries obtained by Mr. Bury, the Chemist in technical charge of the plant; and through the kindness of Dr. W. Hiby, the Managing-Director of the Otto-Hilgenstock Coke-Oven Company, he presents for comparison diagrams contained in a paper read by Herr Hilgenstock in 1902, at the meeting of the German Association of Gas and Water Engineers. Mr. Carpenter also acknowledges his indebtedness to Mr. J. Bond, the Engineer and Manager of the Southport Corporation Gas-Works, for permission to reproduce from his paper before the Institution of Gas Engineers in 1905 three temperature charts showing the effect on carbonization of the employment of normal and lower temperature, the thickness of charge remaining constant, and also the effect of doubling the thickness of the charge with normal temperature. Finally, Mr. Carpenter says:

Mr. W. R. Herring, Chief Engineer and Manager to the Edinburgh and Leith Gas Commissioners, names 2000° Fahr. or higher as the temperature of carbonization in a well-worked gas-retort ["Journal of Gas Lighting," Jan. 23, 1906, p. 216]. He also quotes Professor Vivian B. Lewes as saying that 1700° Fahr. is the upper limit for economical production of ammonia, and that of 100 parts of nitrogen in the coal retorted under ordinary gas-works conditions there is produced, as ammonia, 15 per cent.; as cyanogen, 2 per cent.; as nitrogen in gas and tar, 35 per cent.; as nitrogen in coke, 48 per cent. This estimate would place the percentage of cyanogen (calculated as hydrocyanic acid) to ammonia in the crude gas leaving the retort as 51·2. In last year's report, the percentage of cyanogen to ammonia in the liquors derived from gas-works was, on the average of nine samples

examined, 8·9 per cent.* The liquors may be considered as containing the whole of the ammonia of the crude gas. Hence there is a balance of cyanogen left for recovery, after removal of ammonia. Or, to state the facts in another way, the amount of cyanide in the crude gas as made amounts to the equivalent of about 6 lbs. of yellow prussiate ($Na_4FeCy_6 10H_2O$) per 10,000 cubic feet. After the passage of the gas through the condensers and washing processes where ammonia is removed, it is generally found that of the cyanogen the equivalent of about 2 lbs. of yellow prussiate accompanies the former, chiefly as sulphocyanide, leaving about 4 lbs. (again as yellow prussiate) in the gas available for recovery. In more than one such recovery process, both as ferrocyanide and as sulphocyanide, it is found that the recovery reactions do not proceed with sufficient regularity unless ammonia and accompanying impurities are first removed in the condensers, scrubbers, and washers. In others, again, cyanogen recovery is interposed without regard to such factors as possessing serious prejudicial effects, having regard to the sum of the advantages looked for as compared with the inevitable disadvantages.

After references to salt works and arsenic works, Mr. Carpenter concludes by recording his appreciation of the assistance he has received from his colleagues, and especially from Mr. Linder, in carrying out, not only the administrative duties, but also the experimental work of researches directly arising out of the endeavours to still further diminish the escape of noxious and offensive gases from processes scheduled under the Act.

BENCH FUEL ECONOMIES.

This was the title of a paper read before the Wisconsin (U.S.A.) Gas Association by Mr. F. M. Richards, of Madison. In the course of it, he remarked that in the manufacture of coal gas the gas bench probably plays the most important part. With the average gas company, possibly no other part of the plant is less understood or more abused than the gas bench.

The recuperator form of gas-bench presents almost ideal conditions for efficiency and perfect combustion; and by its use at least 50 per cent. of the bench fuel can be saved over that required in the direct-fired form of bench. In a recuperative form of bench, the waste heat to the retorts passes through the recuperator and gives up a further quantity of heat to the secondary air for the purpose of heating this air. The object in heating the secondary air is to increase the flame temperature of the combustion resulting from the burning of the producer gas with the heated secondary air. In a recuperative form of bench, heated by a producer furnace, the retorts in reality are heated by a system of gas-firing; therefore, the purpose of the producer furnace is to afford a combustible gas largely composed of carbon monoxide and hydrogen.

In the operation of the producer furnace the temperature of the fuel bed has a natural tendency to increase to such a point that there is formed in the fuel bed a fusible slag, which causes a stoppage of the draught current; and as the clinkers fasten themselves to the furnace wall the satisfactory operation of the producer furnace becomes impossible. The amount of producer gas is not only decreased in quantity, but its quality is much impaired. Every character of fuel has a critical temperature, or a temperature at which a fusible mass is formed—"the clinkering temperature of the fuel." For the purpose of holding down, or restraining, this naturally high temperature in the furnace, water and steam have been used in large quantities. The steam passing up through the fuel bed has a cooling tendency or effect, by direct physical contact, and by the cooling effect of the dissociation of the water into its elements, which dissociation is an endothermic reaction.

The use of water or water vapour to restrain the rise of temperature throughout the bed of incandescent fuel is, however, objectionable, because there is loss of heat—due to the fact that as the water must be heated and evaporated from about 60° Fahr. to steam at the temperature at which the waste gases or products of combustion ordinarily leave the furnace stack and pass into the atmosphere (say 800° Fahr. or over) there is a resulting loss of about 1400 B.Th.U.'s for each pound of water thus evaporated. This is shown as follows:

Heat required to raise 1 lb. of water at 60° Fahr. to 212° Fahr.	152·00 B.Th.U.
Water 212° Fahr. to steam at 212° Fahr.	966·00 ,, ,,
Steam at 212° Fahr. to steam or gas at 800° Fahr. (588 × 0·48)	282·24 ,, ,,
	1400·24 B.Th.U.

The specific heat of the steam in the waste products of combustion at the temperature specified, is approximately 0·48; and in the above calculations the heat of the endothermic and exothermic reactions is disregarded. It will be observed in the above determination of the heat lost, due to the evaporation of 1 lb. of water, that no account has been taken of the amount of heat required to dissociate the steam into its elements, hydrogen and oxygen, which is an endothermic reaction, for the reason that the hydrogen is again burned back to steam in the combustion chamber, which is an exothermic reaction, whereby the same amount of heat is given out as was absorbed in the endothermic reaction. For this reason the endothermic and exothermic reactions balance each other, and have, therefore, not been considered in the calculation.

In addition to the loss of heat occasioned by the use of water, as illustrated above, there is a yet more serious objection to its use as a means of preventing the formation of clinkers—due to the fact that, in order to reduce the temperature throughout the entire bed of fuel below the clinkering point, it is necessary to introduce water in such large quantity that the fuel in the immediate vicinity of the water pans and drip plates is reduced in temperature below that of ignition, or the temperature necessary to support combustion.

The proportion of water used per pound of fuel will vary from 33⅓ to 100 per cent. As a consequence, the fuel is quenched, which fact may be observed by opening the cleaning door of the furnace while in operation, and noting that scarcely any live or burning fuel is visible—the furnace presenting the appearance (from below) of a fire that is almost extinguished, while the fuel bed, as viewed from above, shows that a high temperature exists in the upper part of the mass. The unburned fuel in the lower part of the fuel bed is raked down, intermingled with the ash, and is thus lost.

Moreover, it has thus far been found impossible in this type of furnace to entirely prevent the formation of clinkers by the use of water and steam. If enough water is used to reduce the temperature below the clinkering point, there is too great a loss of heat and fuel, while the use of an insufficient quantity of water results in an excessive formation of clinkers, attended with their accompanying evils.

In view of these conditions, the customary practice has been to admit sufficient water, and (if necessary) steam in addition, so that the formation of clinkers will be reduced to such an extent that, by thoroughly cleaning the furnace at frequent intervals, the fuel bed will be maintained sufficiently free to obtain the proper amount of combustion. The clinkering of the fire is in practice attended with great labour and loss of fuel. During the operation of clinkering, the cleaning door necessarily remains wide open—permitting an excessive rush of cold air to pass up through the furnace, and thus rapidly reduce the temperature of the entire structure—resulting in alternate contraction and expansion of all the parts. This produces an increased leakage, and reduces the useful period of the entire structure to a term of but a few years.

Is it a paying proposition to install and use a high-grade bench? The fact that the depreciation in the average gas-bench is so rapid has induced many good gas men to feel that the cheapest bench in regard to first cost is the most economical. The very fact that this depreciation is so rapid is the one reason why this depreciation should be minimized as much as possible.

The Doherty Bench Fuel Economizer.

The invention embodied in the Doherty bench fuel economizer consists in returning beneath the grate bars, and up through the fuel bed, a portion of the waste products of combustion after they have parted with a portion of their heat to the retorts. These products of combustion, mixed with a proper percentage of air, carry on the combustion of the fuel. The carbon dioxide probably dissociates at a lower temperature than does steam in the presence of incandescent carbon; also, this dissociation, which is an endothermic reaction, is much more thorough and complete than is the dissociation of water. By the use of this invention a large percentage of carbon dioxide at comparatively high temperature can be introduced and passed through the fuel bed, and thus restrain and hold down the temperature in all parts of the furnace below the clinkering temperature. In this manner the formation of all clinkers can be prevented and a great saving of heat effected that would otherwise be lost.

In carrying out the process the mixture of carbon dioxide and oxygen should be led beneath the fuel bed at such a temperature, and the proportions of carbon dioxide, free oxygen, and free nitrogen should be such, that the fuel is kept below the temperature at which clinkering occurs—heat being given up to the gases from the fuel. The temperature at which clinkering commences to form varies from about 1500° to (about) 2300° Fahr., depending upon the character of the fuel and the amount of iron and silicon therein.

A mixture of about 4 per cent. of carbon dioxide, 16 per cent. of free oxygen, and 80 per cent. of free nitrogen, at a temperature of about 600° Fahr. is suitable for a certain character of fuel which clinkers at a high temperature; and another mixture of about 10 per cent. of carbon dioxide, 10 per cent. of free oxygen, and 80 per cent. of free nitrogen at a temperature of 700° Fahr., has also been found suitable with another fuel which clinkers at a much lower temperature. The higher the temperature of the gaseous mixture admitted beneath the fuel bed, the larger should be the proportion of carbon dioxide found in the mixture which is necessary to keep the temperature of the fuel bed below the clinkering point. It was found that the mixture of carbon dioxide, free oxygen, and free nitrogen operates satisfactorily if injected at a temperature of from 600° to (about) 800° Fahr., in which case heat is given up to the gas from the fuel and clinkers are not formed. The proportions above mentioned are varied by means of dampers on the injectors. If the ordinary atmospheric air, which contains about 80 per cent. of nitrogen, is used, the per-

* It is pointed out that this figure may be in excess of the percentage produced, since, if in any of these instances devil liquors were returned to the weak liquor well, and so were re-circulated in the liquor going to the still, a percentage figure HCy to NH_3 higher than the actual would be shown by the analysis. For the purposes, however, of the conclusion that follows, this is not material.

centage of nitrogen in the mixture would be the same as in the air and in the products of combustion. The percentages of nitrogen in unburned air and in the products of combustion after the air has been burned with coal are the same; the oxygen being converted, volume for volume, into carbon dioxide when the combustion is complete. The products of combustion are the natural source of the carbon dioxide used in this process; and these, having about 80 per cent. of nitrogen, maintain the proportions of the mixture at 80 per cent. of nitrogen. If carbon dioxide without attendant nitrogen from any other source be mixed with the air, the percentage of nitrogen will be somewhat less. If the temperature of the mixture of air and gases applied to the fuel bed is considerably less than the temperature of the fuel bed, the gases will in themselves (as is well understood) effect the physical absorption of some heat from the fuel bed.

The temperature of incomplete combustion in the furnace is usually carried on at approximately from 1800° to 2000° Fahr., while the temperature of complete combustion carried on in the combustion chamber where the heated secondary air supply is admitted will usually be considerably higher—frequently 2500° Fahr. or more. The temperature of the retorts should be about 2300° Fahr.; and the waste products of combustion, after circulating around the retorts, enter the top of the recuperator at about 2000° to 2200° Fahr.

These products of combustion are cooled down in the recuperator before entering the chimney to between 800° and 1000° Fahr., and a portion of the product is intercepted at a suitable point after heating the retorts, and mixed with air at atmospheric temperature, so that the mixture injected will range about 600° to 800° Fahr. As the appearance of the fire bed furnishes a direct guide to the temperature that is being maintained therein, it also furnishes the best guide for proportioning the quantity of carbon dioxide admitted to get the lowest temperature desirable—it being preferable to admit a little more rather than a little less carbon dioxide.

At Madison, Wis., we have four three-quarter depth benches of sixes equipped with the economizer, part of which has been in operation about a year and a half. On account of our excellent coke market, and as a result of numerous experiments with various grades of bituminous coal used as bench fuel, Youghiogheny lump coal (¾-inch screened) was used under the benches during the year 1906. No changes were made in the benches or their operations other than the installation of the economizers and changing from coke to Youghiogheny lump coal as fuel, together with the refilling of two arches with the Improved Equipment Company's design of bench. A fair idea of the performance of these benches during 1906 over that of the previous year will be gathered from the following:—

	1906.	1905.
Coal gas made	69,669,100 cu. ft.	61,034,400 cu. ft.
Kind of coal used	Youghiogheny.	Youghiogheny.
Coal carbonized	7005·5 tons.	6208·4 tons.
Yield per pound coal	4·97 cu. ft.	4·92 cu. ft.
Cost per ton in shed—coal	$4·03	$3·93
Average number of retorts	18·39	17·41.
Average charge per retort	348 lbs.	326·6 lbs.
,, make per retort	10,380 cu. ft.	9,621·3 cu. ft.
,, make per man—24 hours	30,280 cu. ft.	27,622·9 cu. ft.
Coal or coke used for bench fuel per ton of coal carbonized	201·92 lbs.	404·3 lbs.
Saving in bench fuel (709 tons, at $4·03)		$2,857·27
Saving in bench repairs		146·30
Gross annual saving on four benches		$3,003·57*

* Considerable additional saving would be shown if the additional yield and carbonizing capacity were taken into account.

Cost of Producing this Saving.

Royalty charge—7005 tons at 3 c.	$210·15
10 per cent. annual interest and depreciation on additional first cost	169·32
Gross cost	379·47
Net saving	$2,624·10

$2,624·10 = 155 per cent. annual return on additional investment; or the net saving of $2,624·10 will pay 6 per cent. on $43,735.

It is decidedly interesting to the writer that a still further saving of from 8 to 10 per cent. in bench-fuel is to be effected during 1907.

Average bench-fuel per ton of coal carbonized, from July 1, 1906, to Jan. 1, 1907	182·13 lbs.
Do. Do. Jan. 1, 1907, to May 1, 1907	184·14 ,,

During the latter period, the benches were out of service for six days on account of labour troubles, during which time the heats were maintained about normal.

We learn that on the 24th inst. Messrs. W. A. Valon and Son will remove from their present offices in Temple Chambers to Caxton House, Westminster. Their telephone number will then be No. 3065 Victoria.

The Manchester City Council, on the recommendation of the Gas Committee, have increased the salary of Mr. J. G. Newbigging, the Gas Engineer, from £1000 to £1100 a year, and that of Mr. J. R. Hill, the Manager at the Bradford Road station, from £400 to £450. Numerous other increases were also agreed to.

EVOLUTION OF THE INVERTED GAS-LIGHT.

(*Continued from p.* 667.)

Use of Regulating Nipples.

The quantity of air injected into the mixing-chamber of an inverted burner depends on the size of the openings and the pressure of the gas. As the pressure is bound to vary from time to time and from place to place, and as different mantles vary somewhat in size when in actual use, it is necessary that some arrangement should be made whereby the effective aperture of the nipple can be regulated without taking the whole burner to pieces. The supply of primary air can, of course, be controlled by means of the air inlets; but it does not appear advisable that any method of doing so should be provided beyond the regulation which is automatically effected in the supply of air when the gas-nipple is altered in size. The plan of governing the supply of gas adopted by makers of many inverted burners consists in throttling the gas-way above the nipple with the aid of one or two horizontally disposed screws, having flat ends penetrating to an adjustable distance across the inlet-tube. Another device consists in admitting the gas through an elbow, and placing a screw at the end, which acts as a needle-valve against a seat in the channel. Kleinhans, of Dresden, narrows the gas inlet above the nipple to a parallel tube with a conical inlet, on which a ball lies that can be moved a proper distance off its seat by means of a horizontal thumb-screw. Jost, of Philadelphia, has a somewhat similar arrangement, in which the adjustable gas-orifice is carried in a movable cap fitted with an eccentric handle, so that the ball can be thrown more or less off its seat.

If an adjustable nipple is to act properly, it must be so designed as to regulate the quantity of gas passing without reducing its pressure. With this object in view, the Auer Company, of Berlin, employ a gas-inlet tube with a narrow parallel lower portion constricted at its bottom extremity. Within this tube is placed a cylindrical liner of thin metal, fitted with several longitudinal slits, through which the gas passes. The upper end of the liner bears against the conical head of a horizontal adjusting screw; so that when the latter is screwed inwards, the liner is pressed down in its sheath until the slits are so narrowed as only to pass the desired quantity of gas. Jacob, of Zwickau, has a similar arrangement; but the sheath and liner are tapered, and the latter is pressed downwards in its sheath until the longitudinal slits are blocked by means of a pin fixed eccentrically in respect of the axis of a horizontal lever-headed screw. In a later model, Jacob retains the eccentric pin on the horizontal screw to effect adjustment, but makes the liner an integral part of the burner, and draws the sheath up or down as may be necessary. Ehrich and Grätz, of Berlin, employ a needle valve to choke the nipple of the burner itself, the needle valve being a hollow body working in the gas-way. It is lifted off its seat by means of a spiral spring and forced down again by the thrust of the conical end of a horizontal adjusting screw. Many of these adjusting screws exhibit the defect of becoming too hot to manipulate when the burner is alight. Some of them are therefore fitted with insulated heads. Reiss, of Berlin, has attempted to overcome this difficulty by employing a horizontal spindle with a flange at its inner end fitted with an eccentric pin to raise or lower the needle valve; the flange being pressed gas-tight against part of the burner by means of a coiled spring, and the spindle being fitted externally with a milled or crutch-handle.

Dust-Traps.

The value of any regulating nipple is liable to be entirely lost if, for any reason, the aperture becomes choked up or blocked. This may occur owing to dust in the gas, to dirt in the pipes, or to particles of dried paint. In earlier inverted burners, it was a common practice to put metallic gauzes in the inlet tubes above the nipples; but the gauzes had the natural defect of becoming blocked by accumulations of foreign matter, and so of leading to an insufficient supply of gas. Later burners are therefore usually fitted with special dust-traps, consisting of chambers in which the solid matter is induced to deposit. Hinton and Andrews, of London, cut the inlet pipe in two and place between a structure bored with a zig-zag channel for the gas. At the lowest part of the passage a screw operated from the outside of the structure is fitted, which on removal enables any deposited dirt to be withdrawn. Another plan employed by Ehrich and Grätz, the New Inverted Company, of London, and Richmond, of Plymouth, consists in leading the gas into a chamber closed at its base, within which is an upstanding pipe of smaller diameter closed at the top with either a flat plate or a mushroom head, and having lateral holes for the passage of the gas. The dirt thus collects on the floor of the chamber, whence it can be removed by appropriate manipulation.

In some of these burners the inlet into the inner tube is controlled by means of an adjustable screw, so that the whole device forms at once a dust-trap and a gas-regulator. The Berlin Gasglühlicht Company have adopted a very simple dust-trap, consisting in a removable cylindrical dish with radial holes near the top, placed in a chamber at the end of the gas-inlet pipe. The dish has vertical walls and a flat bottom, and stands on short feet so as not to obstruct the mouth of a pipe underneath it. The proper place for the dust-trap is immediately before the regulating device, and therefore the same Company have brought out a burner in which the same fitting contains at its upper part the dust-trap just

mentioned, and in its lower part the fixed sheath and adjustable silt liner described in a former paragraph. Ehrich and Grätz have a similar combined fitting; but the dust-trap consists of an annulus surrounding an upstanding closed pipe with lateral openings. Spinn, of Berlin, has brought out a burner provided with a trap for any water that may be carried forward with the gas. This trap also consists of a chamber closed at its base with an upstanding central conical portion open at its mouth for the passage of the gas, and with a cock at the bottom for the removal of the liquid. The opening of the cone is, of course, smaller than the diameter of the gas-pipe, but is large enough not to choke the supply.

Lighting Arrangements.

An inverted burner is usually lighted by means of a taper applied either to the opening through which the products of combustion escape, or to the aperture at the base of the globe. The former method is preferable, because the latter sooner or later causes the glass to be soiled with a deposit of soot. To avoid explosive ignition, the taper should be held in position before the gas is turned on. The ordinary self-igniting devices do not work well with inverted burners; and of electrical methods of ignition, only the Borchardt and the "Multiplex" systems are moderately successful. The application of a pilot flame to an inverted burner is not an easy matter, because the small tube leading gas to the pilot is liable to be injured if in such a position as to be permanently exposed to the main flame. Further experiments on this branch of the subject are still in progress, and will, no doubt, lead to a satisfactory solution.

Mannesmann, of Remscheid, has designed a different piece of apparatus to serve as a distance-lighter for an inverted burner. The principle consists in so calculating the dimensions of the burner that the flame which burns normally and heats the mantle when the gas supply is full on, retreats into the mixing-tube, and burns there quietly as a pilot when the gas is checked. A flame will not burn inside the tube if the supply of air coming from the primary inlets is deficient, so that the construction of the Mannesmann burner is largely a matter of experiment. If the nipple has one orifice about 1 mm. in diameter, it should screw into a tube 15 mm. in diameter, and 10 mm. long from the level of the jet. At the base, the tube is suddenly narrowed to a diameter of 9 mm. The air inlets are six holes, 5 mm. in diameter, situated 3 mm. above the jet. If the nipple is provided with eight holes arranged in a circle of 8 mm. in diameter, so as to pass 70 litres of gas per hour at 30 mm. pressure, the wide mixing-tube should be only 8 mm. long, the narrow mixing-tube should be 12 mm. in diameter, and the air holes should be increased to 7 mm. The burners can be operated from the spot or from a distance by means of a cock or cocks having grooved plugs so designed as either to pass the full quantity of gas at the normal pressure, or to reduce it to a pressure of 1 mm. or less. The "pilot" flames may be so small as to become quite non-luminous; and the danger of injuring the nipple by the flame underneath may be diminished by constructing the jet, or the tube where the small flame lies, of some non-metallic refractory material. Further experience of the prolonged behaviour of this system is perhaps requisite before its actual utility can be appraised.

Intensified Inverted Burners for Indoor and Outdoor Lighting.

The effect of fitting an incandescent burner with a chimney for the escape of the combustion products is not merely to increase the supply of secondary air to the outside of the mantle, but also, by increasing the velocity with which the mixture of gas and primary air travels through the tube, to increase the supply of primary air. The heating that naturally occurs in an inverted burner stimulates the ascensional force of the gas, hinders its descent through the mixing tube, and diminishes the volume of air injected; but the application of a chimney to the burner affords means of neutralizing these disadvantages. Moreover, the short flames given by the types of inverted burners previously discussed render necessary the employment of short, broad mantles; whereas the addition of a chimney makes it possible to retain the wide diameter and to increase the length of the incandescence body. In early days makers of inverted burners feared that a chimney would cause the flame to turn upwards immediately it issued from the orifice, so bringing only the upper margins of a mantle to a state of luminosity; but experience has shown this not to be the case. The chimney leads to the formation of a steadier flame, especially when the supply of secondary air arriving through the globe is checked somewhat. The first useful intensified inverted burners had their mantles attached closely to their orifices, so that the burning gases were compelled to penetrate the fabric of the mantles; but more modern varieties are constructed with annuli round the tubes, through which the flames partially escape. In designing an intensified burner, it is particularly necessary to ensure complete separation of the combustion products from the two air supplies. This is very easy to accomplish in the case of the secondary air, by admitting it through apertures left in the globe surrounding the mantle; but such a method of construction is only suitable for burners intended to be used indoors.

Among burners having perforated globes for the entry of the secondary air, the following may be mentioned: Bartlett, of London, places two jackets round the centrally disposed mixing-tube of his burner. The inner is a short length of pipe, open at both ends, and taking the combustion products from inside the mantle. The outer is funnel-shaped at its base, and receives the waste gases from outside the mantle. The outer jacket extends upwards above the injection chamber, terminating in an ornamental hood; while the primary air passes across it in horizontal tubes to the inlets on the burner tube. It would seem that this method of construction may expose the essential parts of the burner to excessive heating. Heimann, of Wilmersdorf, simply carries his burner and globe from a trumpet-shaped cover with a wide stem and an orifice at the top; the primary air travelling, as before, to the injection chamber through horizontal pipes. The orifice for the combustion products is eccentric in respect of the chimney itself, so that the bracket or pendant is protected from injury. Farkas, of Paris, avoids overheating his burner-tube by constructing with perforated walls the part of his chimney which lies below the primary air inlets. Air enters through the holes, and in this way reduces the temperature of the rising combustion products.

Instead of leading the primary air through horizontal tubes direct to the mixing-chamber, Mannesmann, of Remscheid, admits it *viâ* similarly arranged tubes which penetrate the chimney near the top, into a cylindrical chamber surrounding the mixing-tube, and surrounded in its turn by the chimney. The upper part of the chamber, at the level of the air inlets, is broadened; while the mixing-tube increases in diameter towards its base, where it terminates in a wide head with a narrow mouth, whose diameter is about a third of the mantle. This method of construction causes the primary air to be heated before arriving at the injector; and if the temperature rises too much, the volume indrawn may prove deficient. In a second design, therefore, Mannesmann places the horizontal air inlets at the base of the preheating annulus, and provides the burner tube with a second injector below the first; the idea being that a second quantity of primary air shall be drawn into the mixing tube before it has travelled up the chamber far enough to arrive at so high a temperature as the air which is injected at the upper level. When the burner is cold, it is said that practically all the air drawn into the mixing-tube enters at the first injector; but when it becomes hot, the whole energy of the gas is not expended there, so that a second amount of air is drawn in lower down. Such a burner, consuming 80 litres of gas per hour at a pressure of 40 mm., is stated to yield a perfectly non-luminous flame capable of bringing a mantle 70 mm. long by 28 mm. diameter to full incandescence.

In a third design, also provided with two injectors, the preheating chamber only extends over that portion of the mixing-tube where the injectors are; but the air enters at the bottom of an annular space between the two globes and travels upwards in a prolongation of the annulus to short lengths of pipe which admit it to the chamber. The broader internal annulus above the flame carries the combustion products away, and may have webs bolted to its outer walls to increase the heat absorbing power of the air-channel. Proskauer and Co., of Berlin, also have a burner in which the primary air enters through horizontal passages into the base of a closed annulus surrounding the mixing-tube, and thence to the injection chamber at the top; the outer annulus being the chimney, and having a final outlet that can be rotated to keep the gases away from the fittings. In this burner the air-heater is provided with a spiral web or with partitions having staggered holes, so that the air is forced to travel a considerable distance through hot metal. Shaw, of Walsall, places the injection chamber of his inverted burner in a structure composed of three converging horizontal tubes of wide diameter; the products of combustion passing through apertures in plates situated in the sector-like spaces on their way to the chimney.

A second group of intensified inverted burners are fitted with globes closed at the base, and are fed with cold primary air. The Wolfflicht Company, of Berlin, use the space round the mixing-tube of their burner as the chimney, covering it with a curved hood at the top to protect the primary-air inlets, and giving it a wide trumpet mouth at the base. The secondary air enters above the lip of the globe, travels downwards, and impinges against the trumpet before reaching the mantle. In another pattern the secondary air, entering at the top, is warmed by passing through holes in, or under the lower edge of, a glass cylinder round the mantle; while the chimney is provided with a deflecting cap in the same manner as before. A specimen of this burner, examined by Wedding, developed a mean hemispherical illuminating power of 126·5 Hefners from a consumption of 132 litres per hour at 39·5 mm. pressure, exhibiting a duty of 1 Hefner per 1·04 litres.

In order to limit the extent to which the mixture of gas and primary air is heated, Ehrich and Grätz, of Berlin, only allow the rising combustion products to play against the walls of the mixing-tube for part of its length; two flat vertical partitions crossing the chimney, so as to protect the upper portion of the tube from the heat. Near their tops, the partitions are splayed outwards, and direct the waste gases away from the primary air-inlets. The secondary air enters at a level with the top of a glass cylinder round the mantle, and passes downwards and up again before reaching the flame. The injection chamber of this burner has the combined regulating nipple and dust-trap already described, and the first portion of the mixing-tube is made much narrower than the latter, where a gauze is fixed. When desired, a pilot flame can be fitted, which is preferably of the bunsen kind. The mantles are 26 mm. in diameter and between 37 and 43 mm. long. Run at a pressure of 35 mm., a large-sized burner consuming 90 litres per hour is stated by the makers to develop

about 110 Hefners, and a small-sized burner, consuming 65 litres per hour, to yield about 80 Hefners measured horizontally—*i.e.*, a duty of 1 Hefner per 0·82 litre. Francis, of London, recently designed a burner in which the depending gas-supply pipe is branched stirrup-fashion into a horizontal ring lying well outside the chimney for the escape of the combustion products. From this ring one or more convergent horizontal mixing-tubes penetrate the walls of the chimney, where they turn down to yield one or more inverted flames. The burner is employed with a closed globe, the secondary air entering at the top, and playing over the surface of the chimney before reaching the flames. As the chimney extends above the level of the mixing-tubes, the primary air is kept both cool and pure. The burner forms either a single or a multiple unit.

Voigt and Mader, of Hamburg, and Bachner, of Berlin, have brought out inverted burners intended for use with single mantles of large size. Bachner subdivides his depending supply pipe into numerous complete injectors and mixing-tubes, which approach one another near their outlets, and are arranged circumferentially within the mantle. The mouths of the burners are cut off obliquely, and point outwards, so as that the flames play upon the sides of the mantle. The central space of the entire burner is the chimney for the combustion products. The primary air enters near the top, and the secondary a little lower down, travelling between a closed outer globe and an inner one till it reaches the inlet at the base of the latter. In another design, Bachner makes the individual mixing-tubes terminate in an annular chamber surrounding the chimney inlet; the said chamber having radial slits at which the gas burns. Brillouin, of Paris, has also designed a somewhat complicated lamp having an eccentrically disposed gas supply and injection chamber. The mixing-tube is fitted with two round elbows to render it finally concentric, and a second supply of primary or intermediate air enters through horizontal pipes traversing the base of the chimney and communicating with an annulus round the combustion orifice. The true secondary air enters through short vertical tubes in the cover of the closed globe. Another French burner has an eccentric gas supply and a horizontal injector; a Kern-like inverted perforated cone being placed in the concentric end of the tube. This burner has several inlets for intermediate air, which rises in a bell closed at the top, passes through horizontal pipes crossing the annular base of the chimney at different levels, and descends in an inner annular chamber alongside the burner orifice.

Manifestly the various methods outlined above for heating the gas, the primary air, and the secondary air, and for drawing away the combustion products, may be subjected to endless modifications, and the apparatus so constructed may be regarded as "regenerative" inverted incandescent burners. The fundamental type of such a burner consists of a cross-shaped tube, the upper vertical member of which is the gas-inlet, and terminates in a nipple at the common junction; while the horizontal members are the primary air inlets, and the depending member is the mixing-tube that also supports the mantle. The outer ends of the air inlet pipes carry a hollow parallel cylinder for the aspiration of the combustion products; and the bottom edge of the cylinder is lower than the perforations in the globe-gallery through which the secondary air enters, so that the air is warmed by contact with the hot metal. Several firms have introduced burners built on these lines, some of which comprise regulating devices for the gas or primary air, or both. Frister, of Berlin, has such a lamp in which the secondary air is heated to a high temperature on its way downwards from the top of the outermost annulus of the burner to the mantle below. This system is said to have the additional benefit of keeping the visible part of the burner reasonably cool; so that it does not tarnish readily. Frister's burner is stated to develop 100 Hefners from a consumption of 90 litres of gas per hour.

Inverted burners intended for use in the open air must be carefully arranged in order that wind and rain may not affect their good behaviour. As a rule, the air enters into an enclosed chamber protected from the combustion products, and there subdivides—part going to the injector inlets, and part to the exterior of the mantle. Generally, too, the outside lamps are provided with two concentric chimneys, the inner one (which is not carried so high as the other) serving for the escape of the burnt gases; while the outer casing is simply an open channel for air which enters at the base and escapes at the top—part of it being diverted during its ascent towards the primary air inlets. When the lamp is a multiple unit supplied with gas from a common pipe, the injector chambers for each burner are usually situated within the outer casing—an arrangement that prevents excessive heating of the burner tube and of the mixture of gas and primary air. It also simplifies the adjustment of the gas supply to each nipple, since the regulating devices can be fitted with horizontal thumb-screws projecting through the walls of the casing into an accessible space covered only by the solid removable globe gallery. In some of the latest outdoor burners constructed by the Kramerlicht Company, of Berlin, the gas supply passes down concentrically within two casings (in the manner already described) to the base of the lamp structure. Then it turns horizontally outwards to the periphery, where a short length of vertical pipe joins it to a horizontally disposed mixing-tube which lies immediately beneath the centrifugal tube. The injector is situated at the spot where the vertical connection joins the lower tube, and is arranged horizontally with a projecting regulating screw. Both horizontal tubes are of cast iron, as is also the lower extremity of the chimney. Francis, of London, has a similarly arranged multiple lamp; the horizontal injectors being fed with gas from a horizontal ring-shaped pipe.

(To be concluded.)

YORKSHIRE AND MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATIONS.

Mr. J. H. Brearley had intended that the visit of the members of the Manchester and District Institution of Gas Engineers to his works at Longwood should during his presidential year be followed up by a joint visit of the two Junior Associations of Lancashire and Yorkshire. Various reasons, however, led to a postponement of the arrangement; and the visit finally took place on Saturday, when the district enjoyed the finest day (and almost the first dry one) of the past two or three weeks.

A detailed description of the works appeared in these columns recently (Vol. XCIV., pp. 583-5); while the Toogood patent charging machine and the Dempster and Mitton patent discharger were illustrated and described about the same time (Vol. XCIV., pp. 162-3). These naturally were the chief features of interest and novelty, and the more so as at the previous meeting the members of the two Associations had inspected the Fiddes-Aldridge machine in operation at the Eccles Street works, Liverpool. An illustrated description of the machines had been prepared by Messrs. R. Dempster and Sons, and a copy was presented to each visitor; while Mr. J. W. Broadhead, the Managing-Director of the firm, and Mr. Toogood, the inventor of the charger, were both in attendance to explain their specialities. The machines, which were unfortunately temporarily out of action on the occasion of the Seniors' visit, were now working smoothly and successfully, and their action and mechanism were closely followed; full advantage being taken of the opportunity of freely questioning the representatives of the makers. Attention was called to the fact that the machines could charge and draw single retorts (as had been actually done at Longwood); and this also helps to demonstrate their adaptability for small works as well as for larger ones. The present installation, in a small and low house on a steep hillside, presented a useful object-lesson as to the method of surmounting these difficulties, partly by alterations to the house, and partly by modifications of the machine. Many comments were made on the evenness of the charge, the small amount of dropped coal, and the thoroughness and ease of the discharging.

Mr. Brearley's patent regenerators came in for full scrutiny; and advantage was taken of the chance of seeing deep and shallow regenerators and simple generators all in one house, and side by side. Originally all had been direct-fired; and their conversion necessitated the extension of the pier walls downwards for a distance of over 8 feet. As the chimneys are built on the stack, this work, and the requisite underpinning, needed very careful carrying out; and though successfully achieved, the visitors were not surprised to find some amount of irregularity in the levels of the retorts—necessitating a readjustment of the machines for practically each retort.

Everitt's tar-extractor (fixed near the inlet to the condensers) was described and commented on, as was also the 95 feet two-lift Gadd and Mason holder. This had been erected by Messrs. R. Dempster and Sons to replace a single-lift holder that came to grief in 1902. Mr. Brearley explained the circumstances of the accident, and bore emphatic testimony to the steadiness and smooth working of the spiral-guided type of holder. Provision is made for the future addition of a third lift outside the two at present erected. The advantage of a continuous diagonal plate, to which the guide-rail is fastened, was pointed out; no riveting being thus covered up, and all rivets being open to inspection for leakages.

In the laboratory an unexpected object of interest was on view consisting of the elaborate installation of fittings and apparatus for the investigation of the working of gas-fires, upon which Mr. Brearley has been spending much time during the past year or more, and of which the results will be given in his paper at the forthcoming annual meeting of the Institution of Gas Engineers in Dublin. While, of course, not antedating the reading of that paper, nor divulging its results or the details of its methods, Mr. Brearley's brief description of the attachments to the stove was sufficient to whet all appetites, and will ensure a close perusal of the paper when it appears in the Technical Press. Showing the visitors round, the Engineer's Assistants, Mr. J. W. Brearley and Mr. E. Sainter, rendered acceptable service.

After completing the circuit of the works, all returned by car to Huddersfield, where Mr. Brearley, with characteristic consideration and generosity, had provided high tea at the George Hotel. After the meal, the opportunity was embraced of thanking Mr. Brearley and the others who had assisted in making the visit so pleasant and profitable.

Mr. W. CRANFIELD, in proposing an omnibus vote of thanks, expressed his regret that the Yorkshire President, Mr. G. W. Fligg, was unavoidably absent. They all congratulated him on that morning's announcement of his appointment as Engineer and Manager of the Dewsbury Gas-Works. It was a happy coincidence that it had come during his year of office; and they were glad that the joint visit of that day enabled their congratulations to be prompt, and gave them

additional weight. They rejoiced, not only that a worthy and popular President had been thus promoted, but also that a public body had so signally acknowledged and rewarded the many years' faithful service of one of their subordinate officials, and that in this case a prophet had found honour even in his own country and among his own people. In Mr. Fligg's absence, he begged to propose a hearty vote of thanks to Mr. Brearley for his kindness in giving them the opportunity of seeing his works, and in making such full provision for their professional edification and their material comfort. They recognized in him one who had been most powerful and active in assisting their Association, and one who was enthusiastically ready to promote the interests of all the young men of the gas industry. In many ways not open to the public eye, he had rendered great help and given invaluable advice in the inception and inauguration of their Association and in its subsequent working. He had been a "friend at court" to them, too, and in high professional circles had laboured for the good of the engineers of the future. Not only in private but in public, he had stood by them, had visited their meetings, had addressed them, and had identified himself with their interests and work. Speaking for himself, remembering as he did, and gratefully acknowledging, a uniform kindliness and helpfulness from all engineers he had been brought in contact with—both in his private capacity and in connection with the Association—with none had he had more intimate relationship than, and none had been in a position to render him such invaluable service as, their present host. He was glad of this public opportunity of expressing his admiration of, and thankfulness towards, Mr. Brearley; and if he had been in any way able to render some humble services to the profession through its young men, he attributed much of it to sympathy, advice, and support of the Longwood Engineer. He was glad they had Mr. Brearley in their district, and that his person and his work were alike familiar to them. He was a constant inspiration to them. He had early risen to a high position in his profession, and he had owed it almost exclusively to his own native ability and character, and to his own efforts—he had in short carved out his own career, and been the engineer of his own fortune. They thought of him also now in a new capacity. He had received a signal honour and mark of confidence in being appointed the Examiner in the new technical subject of "Gas Distribution and Supply." As the first Examiner, he had the great opportunity of ploughing a fallow field, and he would probably leave a deep impression, and have a wide-spreading influence, on the professional training of important sections of gas employees for many years to come. They heartily congratulated him, rejoiced in his appointment, and wished him high success. He had the inestimable gift of a keen-sighted sympathy and a sense of humour and proportion. He knew much of the conditions of work, and the equipment of the class of men whom he would examine; and his fellow members of the Council of the Institution had emphasized their confidence in his fitness for the post. The members present also tendered their thanks to Mr. Broadhead. The name of the firm of Messrs. R. Dempster and Sons was familiar to them all; and the neighbourhood was quite historic ground in its connection with several of the great firms of gas-works contractors. They congratulated the firm and Mr. Toogood, one of the patentees, on the possession of the specialities they had that day seen. They had all appreciated the honour and realized the benefit of their attendance and assistance in person; and he assured the members that this was but typical of the attitude of the firm, to whom he had for years past been under no small obligation for assistance in connection with his classes in Gas Manufacture.

Mr. Alsop (Stockport), in seconding the vote on behalf of the Manchester and District Association, said that he wished heartily to concur in the words of appreciation and thanks just spoken. They had greatly enjoyed themselves, and seen much that was well worth coming to see. What they would carry away with them would furnish food for reflection, and result in ultimate good to them. They prized the privilege of being allowed to see from time to time the various forms of modern plant and appliances. It was not theirs to criticize these—at least, not publicly—or to say which was best. The determining factor was often local circumstances and requirements; but when the time came for any of them to make decisions as to what was best and most desirable under given conditions, they would then be able vividly to appreciate the advantage of this personal inspection of the working of various types of plant. For most of them it was their first opportunity of seeing the machines. They had read of them, of course; but had it not been for the privilege that day extended to them by Mr. Brearley, it might have been a long time before they had a chance of actually studying them in operation.

Mr. Brearley, in responding, acknowledged the cordiality of their vote of thanks, and said he had had great pleasure in thus welcoming and entertaining his fellow members of the Junior Association, for he never cared to accept honorary membership that involved no obligations. He felt himself quite a young man, and hoped for many years to retain his youthfulness of heart and to keep in close touch with the young men. He hardly knew if he deserved all the compliments and kind remarks that had fallen from Mr. Cranfield's lips; but they would at least embody his aims, and he should certainly endeavour to reach such a standard. In referring briefly to his appointment as Examiner in "Gas Distribution and Supply," he thanked them for their congratulations, but thought that he should be wise in his day and generation if he determined to refrain from public references to the work that lay before him. Referring to the machines seen that afternoon, no one knew like Mr. Broadhead and himself what had been the difficulties in connection with them, as with all pioneers of a new invention. The Directors of his Company and the Contractors had acted in sympathetic co-operation, with the result that excellent working had been secured and the machines were wholly satisfying them. The difficulties had been very little in the machines, but arose mainly from the exigencies of the situation in which they had to work, and for which they had to be specially modified. They had seen how cramped for room the works were, and how they had been obliged to add 6 feet to the width. In converting the old direct-fired settings into full regenerators without entirely demolishing the bench and renewing the house, they had had to resort to underpinning while deepening the pier wall. Under these circumstances, the retorts of one tier were not all at exactly the same level; as wide a range of difference as 7 inches existing. This necessitated repeated readjustments of the level of the machines; so that no fair calculations as to the total time of dealing with the retorts could be made from what they had seen. Other special local circumstances had introduced numerous difficulties, many of which were only realized after the installation had been made. He said this in duty to the Contractors, and in justice to his Company. He doubted if any other gas-works had forced upon it a greater economy of space, and on $\frac{3}{4}$ acre made 110 million cubic feet of gas per year, had storage for half-a-million cubic feet, dealt with all coke and coal, and carried out all the purification, revivification, and other details of manufacture as they did at Longwood. Some queries had been put as to the heats of the settings. The employees had had their annual outing during the week; and for a great part of Wednesday and Thursday they had given up carbonization. They had followed their usual works custom, and were neither forcing their heats nor temporarily altering their air-slides, &c., but were letting the heats slowly recover themselves. Apart from their questions to him, this explanation was due to the Contractors as well, as, of course, carbonization was better with higher heats, and the discharging of the retorts better with crisp, well burned-off charges. It was a pleasure to him to bear witness to the exemplary conduct and bearing of all his workmen in connection with their excursion, and their prompt resumption of vigorous work. He had been associated with good helpers in all departments, who had served him excellently. He appreciated their labours, and attributed no small part of his success to the way in which they had served him. He believed in delegating responsibility, and in letting all his young men have opportunities of acquiring personal knowledge and experience of the details of the work and administration, while he yet had all the strings in his hands. This delegation had never been misplaced, and all had risen to the occasion and justified the confidence reposed in them. Finally, he was glad they had appreciated their visit; and even if it was the last joint visit, he hoped it would not be their last visit in their individual capacities.

Mr. Broadhead said he was pleased to make their acquaintance. He was alive to the great possibilities of usefulness that their Associations embodied, and tendered them collectively and individually his best wishes. He thanked Mr. Cranfield for his kindly references to the firm; and as he knew a good deal of what that gentleman had done for the young men and for the Association, he thought they ought to be proud to have him in their midst. He was grateful to Mr. Brearley for arranging this visit to Longwood. Mr. Toogood also briefly responded.

On the motion of Mr. Brearley, seconded by Mr. J. C. Wellens (Hebden Bridge), cordial congratulations were forwarded to Mr. Fligg on his promotion from Assistant-Manager to Engineer and Manager of the Dewsbury Gas-Works. Special mention was made of the fact that he went as a lad direct from school to the old gas-works, had seen the present works built, and had risen through the various grades to the highest post. Mr. Wellens added the note of personal appreciation of the situation, as after being put on the short list for the managership of the works where he had been brought up, the first step in the ultimate decision was to insist on choosing a non-local man.

Sir George Livesey and the Southern Junior Association.

The following is an extract from a letter received by Mr. W. J. Liberty, Vice-President of the London and Southern District Junior Gas Association, from Sir G. Livesey, in respect to the telegram of birthday congratulation sent on the occasion of the visit of the Association to the East Greenwich Gas-works on the 1st inst.: "I want to thank the members of the Junior Association for their very kind telegram of Saturday last; and to say that I follow with much pleasure the reports of their interesting, useful, and practical proceedings, and only wish I could show in a practical way my sympathy with them and their useful work. I was glad to read the account of the visit to the East Greenwich Gas-Works. You know my age; and as I find increasing years seem only to increase occupation, that must be taken as the reason why I have never been able to take any part in your proceedings, much to my loss and regret. However, you are quite independent, and need no assistance—in fact, seem to be the better without it, which is as it should be."

Iron Pipes in Turkey.—Cast-iron pipes for water-works were first imported into Turkey in 1882, when a French company undertook the water supply of Constantinople; and a considerable number are still imported every year, both for the extension of the system and the renovation of existing works. All these, which are of the type known as spigot and socket pipes, are furnished by a French firm; others come from Belgium. The Ministry of "Evkaf" [religious foundations] is also a large purchaser of cast-iron pipes; and when (very rarely) large quantities are needed, public tenders are invited from foundries in Europe. As a rule, however, the local merchants supply the demands of this Ministry, whose tests of strength and conditions are not very stringent. A demand for cast-iron water-pipes for the interior of houses and for rain-pipes, with accessories, such as gutters, cones, &c., has sprung up within the last ten years; the sales in Constantinople last year amounting to 250 tons. It appears certain that cast iron will be more generally employed for these purposes in place of zinc and stoneware. The usual dimensions of interior pipes are 54, 67, 81, 94, 108, 121, 135, and 162 millimetres in diameter, and 25, 50, and 100 centimetres in length. The dimensions of the other pipes vary according to needs; those used by railway companies ranging in diameter from 40 to 100 millimetres; while the water companies in some places employ pipes of a diameter of 800 millimetres.

THE ASSOCIATION OF WATER ENGINEERS.

ANNUAL MEETING AT WINDSOR—JUNE 6 to 8, 1907.

THE Association of Water Engineers have during the past few years been taking a very direct course to the improvement of their status; and if their success has not been rapid, it has been very sure. It has been uphill work; but the Association is now so firmly established that it commands respect, its co-operation is invited, and it has within it the capacity for good and useful work in connection with all matters appertaining to water supply. Such an Association of men engaged in the profession of water engineering is now more essential than ever. Every day, with the growth of population, and with the liability—through such increase, and through the extension of industry and land occupation and cultivation—to the contamination of water supplies, enlarges obligations and necessary watchfulness; and the responsibility for the preservation of health becomes more and more onerous. We know of no profession, considering all this, that merits encouragement in all endeavours to gain knowledge by conference, and by opportunities for the collection of experience, so much as that of water engineering. Therefore we are pleased to see the encouragement that the Municipalities of the country give the Association, as was instanced by the warmth of the reception accorded to the Association last week in the Royal Borough of Windsor, the Corporation Water Engineer of which (Mr. Christopher Sainty) is this year President of the Association.

It was a source of great regret that the President is not just now in his usual robust state of health; but with the members our wishes are that his restoration may be speedy and complete. In consequence of this, his address was short; but it was pregnant with matter which testifies both to the recognized utility of the Association, and to the necessity for full encouragement in the useful work which they have in hand. He emphasized the importance of unity among water engineers; and his advocacy of the justness of the claim that officials who attend such conferences as those of the Association should have their expenses in connection with them paid from the local exchequers was very much to the point. This was a matter that was brought out in the annual report of the Council of the Institution of Gas Engineers as published last week. From the references in that report, and from what the President of the Association of Water Engineers now says in his address, we do not gather that all the organizations concerned in this question have combined to bring their views before the Local Government Board, and to agitate the matter to some conclusive end. In unity is strength; and this potent aid to the enforcement of a just claim should be adopted, if it has not been, to the fullest possible extent. True something is, as is seen by the President's remarks, being done in this direction; but is all being done that might be done? We cannot understand the hesitancy of the powers that be in this matter. Local government is a heavy burden upon the ratepayers at the present time; but there is in evidence, stronger than ever, the penny wise and pound foolish policy. We know well the officials of municipal authorities; and we know, too, that the comparatively insignificant amount—insignificant to the undertakings that they serve, although a burden when it is made an individual matter—that requires to be expended upon their professional conferences is a useful expenditure in the cause of efficiency. The gathering of experiences and opinions that such conference permits, and the visits of inspection to works—such as to the Staines Reservoirs and to the water-works of the Windsor Corporation on the present occasion—and inquiry into method afforded, are results of value which do not remain the personal possession of the official attending such conference. All his accumulated knowledge is brought to bear upon his daily work. That is an effect that he cannot repress; and therefore it is not the official—be he an engineer or otherwise in the municipal service—who reaps the advantage, but the undertaking of which he has charge, and through the undertaking the community. We hope that the President of the Local Government Board will be persuaded to take a broad view of this matter; and institute the necessary steps to legalize the payment of such expenses. In connection with large municipal undertakings, it is very easy for Committees, if they so will, to pay such expenses from the funds of the undertaking; but in the case of smaller undertakings it is not so easy. And it is in connection with the small and medium-sized undertakings where the pinch of expense is most keenly felt by the officials. If, however, the payment of expense is hereafter authorized, there ought to be some sort of regulation; but from what we know of local authorities, there will be no difficulty over this.

We have spoken of the continued advance in status of the Association and its recognition in work for improving the conditions of water supply. Corroboration is afforded in the President's address. In numbers, the Association is forging ahead; there having been before last week's meeting no less than 322 members, associate-members, or associates on the roll of the Association, and several others were added during the meeting. Financially, too, the Association is now in an excellent position. Among other useful work upon which the Council have been engaged with others has been the preparation of a new model code of regulations for the prevention of waste. This model code has been prepared, with detailed specifications for fittings, and submitted to the Local Government Board. It is now in process of revision, with a view to early publication; and it is with confidence anticipated that, as regards the most vital points, it will be issued under the express sanction of the Local Government Board. But it is hoped that the result of the work of the Joint Committee will be to induce uniformity of practice, so as to merit official and full legal sanction. When we are told by the President that he is convinced that in the majority of towns in the country at least 25 per cent. of the water delivered to the consumer is wasted, involving a large capital and working expenditure, we do not require any other consideration to impress the importance of doing all possible to prevent the continuance of this waste. It is hoped that there will be success in this direction.

There were many other matters in the Presidential Address which were of more than passing interest. A unique feature of it was a number of photographic reproductions of old prints now in the possession of Eton College, which show that the application of mechanics to water supply is an ancient one. Space prevents their reprinting in our columns; but they will all appear in this year's volume of "Transactions," the value of which will, in consequence, be very considerably enhanced.

The papers presented at the meeting proved of good technical value. Dr. Thresh introduced a new and simple means of tracing the source of the pollution of underground waters. Mr. R. C. J. Dicken showed there were purposes and conditions, without claiming universality, to which high-pressure centrifugal pumps can be economically applied; and in separate papers—one by Messrs. W. Gore and Martin Deacon jointly, the other by Mr. A. M. Cobban—there were presented some highly interesting features in modern engineering as applied to water-works on a limited scale. The visit on Thursday to those stupendous engineering works the Staines reservoirs of the Metropolitan Water Board was a great treat for many of the members; and the kindness of the Board's Chief Engineer, Mr. W. B. Bryan and of the authors of the scheme—Mr. Walter Hunter and Mr. R. E. Middleton—was deeply appreciated. The importance of utilizing the sources of water provided by Nature near at hand in the supply of cities and towns, was emphasized by Mr. Hunter in his speech at the annual dinner, when he said that the saving to the ratepayers by taking advantage of the Thames through these Staines reservoirs and not going to Wales for an additional supply was represented by something like 30 millions sterling.

The meeting was a most successful one in all respects; and the President and the Mayor and Corporation, with the Secretary of the Association (Mr. Percy Griffith) were the centres of activity from which that result proceeded.

REPORT OF THE PROCEEDINGS.

The Twelfth Annual General Meeting of the Association was held at Windsor from Thursday to Saturday of last week. The proceedings were opened in the Guildhall on Thursday morning; and there were then about 80 members present. A number of ladies graced the opening function.

Reception by His Worship the Mayor.

The MAYOR (Alderman James Brown, J.P.) attended, accompanied by the Town Clerk (Mr. E. Cecil Durant), to

offer the members welcome. His Worship said, on behalf of the Corporation and himself, he bid the members a hearty welcome to the royal and ancient borough. He was certain they could not have elected anyone better than Mr. Sainty, the Corporation Water Engineer, as their President for the coming year; and he was sure, under Mr. Sainty's rule and guidance, the Association would flourish. He (the Mayor) had looked over the rules and regulations of the Association; and he thought they were admirable. He quite agreed with the idea of working in the forenoon and taking recreation in the afternoon. There were in Windsor—and the inhabitants were proud of it—many sights for their visitors to see. There was the historic Castle, the noble river, and over the bridge they had the renowned college of Eton. It would take all the leisure time of the members to visit these different places. That afternoon he understood they were going to visit the Staines Reservoirs—a great work of water engineering; and he hoped the visit would be both pleasurable and instructive.

The retiring PRESIDENT (Mr. William Millhouse, of Scarborough) said it gave him very great pleasure to propose a vote of thanks to his Worship and the Corporation for inviting the Association to Windsor for their meeting this year, and to his Worship for the kind and hearty way in which he had welcomed them that morning. It was a great pleasure to be welcomed in such a manner; and it assured them that the Association was well thought of, and was growing in favour year by year. They had had many hearty welcomes, but never heartier than the present one; and he thought they would all agree with him when he asked them to accord a vote of thanks to the Mayor and Corporation.

Mr. WILLIAM MATTHEWS (Southampton) remarked that it was a great pleasure to him, at the request of the Council, to second this vote of thanks to the Mayor and Corporation. This was the second occasion he (Mr. Matthews) had had the pleasure of coming to Windsor to be received by the Corporation; and he was sure the visit they were paying at the present time would be quite as satisfactory as their recollections of the former visit. He coupled with this hearty congratulations that they were meeting under the presidency of their old friend Mr. Sainty, to whom he was sure it must be a great satisfaction that the Association had again come to the town over the water-works of which he so ably presided.

The motion was carried by acclamation.

The MAYOR thanked Mr. Millhouse and Mr. Matthews and the members generally for their cordial acknowledgment. He was pleased indeed to have the opportunity of seeing the members in Windsor; and he wished them every success and pleasure.

Minutes of Last Meeting.

On the members reassembling,

The SECRETARY (Mr. Percy Griffith) read the minutes of the proceedings at the meeting of the Association held at Burlington House, on Saturday, Dec. 8 last; and they were unanimously confirmed.

Induction of the New President.

The PRESIDENT said it was now his duty to retire from the position which the members so kindly conferred upon him a year ago. He did not feel competent to say very much with regard to himself; but he must thank the members most sincerely for the way they had supported him on every occasion in carrying on the heavy and onerous duties of the presidency. He trusted the Association had advanced during his year of office, and that it had been in all respects satisfactory. He had endeavoured to promote good feeling among the members, and also to induce the younger members to bring themselves somewhat more to the front. That was a particularly good effort on the part of a President; and he hoped it would be continued. He could not retire without expressing his thanks to the Secretary for the great assistance he had rendered in enabling him (the President) to fulfil his duties. In Mr. Griffith, they had a model Secretary. He also thanked the members for their kindness to him. It was with great pleasure that he now asked Mr. Sainty to assume the office of President. He (Mr. Millhouse) thought that the members had elected the right man for the right place. He had known Mr. Sainty ever since the institution of the Association at Nottingham. They met then as perfect strangers; and friendship had grown up between them as it had done between many others during the meetings of the Association. He was quite sure the Association would benefit during Mr. Sainty's year of office, through the great ability and energy he would throw into the work, which he was sure he had very much at heart.

Mr. SAINTY then took the chair, amid enthusiastic applause.

The PRESIDENT remarked that it was extremely kind of the members to have elected him as President of the Association. He was sorry he was not in the state of health he should have liked to be in to meet the members that day. But through the kindness of his friends—the late President and the Secretary—he was sure the work would go on equally as well as if he did it all himself. At the same time, it would cause him some anxiety to fill the office Mr. Millhouse had so ably occupied during the past twelve months. His year of office had been an enjoyable one, and, in addition, it had been very interesting and instructive. He had the greatest pleasure in proposing a hearty vote of thanks to Mr. Millhouse for the way he had conducted the business of the Association during the twelve months.

Mr. P. H. PALMER (Hastings) was sure that the members would be all agreed in according this vote of thanks. The meeting at Scarborough was a very great success—in fact, he thought it was as successful as any meeting they had had, and this was due almost entirely to the efforts of the President. In spite of his modesty, he had got through the year exceedingly well. The general feeling among the members was that he had done the Association a great deal of good, and had left the chair with the Association in as prosperous a state as, or in a more prosperous state than, before. He (Mr. Palmer) seconded the vote of thanks with much pleasure.

The motion was carried by acclamation.

Mr. MILLHOUSE thanked the members most sincerely for their vote; remarking that this was one of the most agreeable events of a year of office to any President.

INAUGURAL ADDRESS.

The PRESIDENT said he would ask the Secretary to read his address, as he had been to his medical adviser that morning, and had been told that he must do as little as possible, in view of the weak state of his nerves.

The SECRETARY, before reading the address, said that, departing from custom on this occasion, copies of the address had been distributed, as a great deal of the interest centred in the illustrations which accompanied it. The address was as follows.

Gentlemen,—It is my first duty, as well as a great privilege, on such an occasion as the present to thank you for the honour you have conferred upon me, and incidentally upon this Royal Borough of Windsor, in electing me President for the coming year.

When our Association was first formed at Nottingham, it was intended to limit the membership to engineers and managers in charge of water undertakings; but since then it has been decided by the Council—a decision confirmed by the members on many occasions—to admit within our ranks consulting water engineers with experience of water-works construction in various parts of the United Kingdom and abroad. This extension of our membership must, I am confident, be beneficial in enhancing the prestige of the Association as well as by increasing our membership. I would cordially invite all engineers in charge of water undertakings, or whose experience provides the needful qualifications, to promote the interests of the profession by joining our ranks and using their influence to increase our membership roll and in every way strengthen the status of the Association.

Membership.—Dealing with the present position of the Association and the work accomplished during the past year, it is satisfactory to observe that our membership roll shows a slight increase, notwithstanding the fact that our losses from death and other causes have been considerable. To secure the financial stability of the Association, the Council make a practice of cancelling all members who, from any cause, fall into arrear with their subscription; and as many of these cases are foreign and colonial members temporarily lost sight of, this loss is not necessarily permanent. The figures for the past three years are as follows:—

Membership Roll, Jan. 1.	1905.	1906.	1907.
Honorary Members	2	2	2
Members	200	206	208
Associate Members (previously Associates Class A)	73	86	90
Associates (previously Associates Class B)	30	33	32
Totals	305	327	332

The large number of new members offering themselves for election at this meeting is a good augury as regards our membership roll at the end of the present year.

Transactions.—In this respect, as in others I shall refer to, my predecessor, Mr. Millhouse, is entitled to very hearty congratulation. The volume issued during his presidency was almost the largest ever published by the Association, and the matter it contains will be found to be of great value to all water engineers. The fact that the volume was sent out at a much earlier date than in previous years is also one for which congratulations are due to our Secretary. It must have involved much labour and enthusiasm on his part to have issued such a large volume in so short a time. The improved form in which the Library Catalogue has been issued will also be appreciated by members, and I would like to take this opportunity of thanking those gentlemen who have so generously presented valuable works of reference to the Library—particularly Mr. Whitaker for the geological bulletins published by the United States Government. The Secretary reports that the Library is not as much used as it might be, and he asks me to state that he will always welcome any member who may wish to refer to any of the books or pamphlets. It is necessary to point out, however, that these cannot be lent or removed from the Library. By the new arrangement recently made in regard to the printing of the "Transactions," the annual cost has been reduced, and at the same time improvements have been effected in regard to details of binding, reporting, &c., which will no doubt have been noticed and appreciated by all.

Finance.—The statement of accounts for the year 1906, together with the report of the Honorary Auditors, which appear in the "Transactions," are both of a satisfactory character, and afford ample evidence of the substantial progress which the Association has made during the first eleven years of its existence. The fact that we now hold Consols of the nominal value of £500, representing accumulated surplus funds, is the best proof that the Association is now firmly established and has completely emerged from the tentative or experimental stage of its history. It is also satisfactory to know that this reserve is altogether additional to the stock of "Transactions," the value of which has, under the advice of our official Auditors, been written off out of last year's surplus, and will not appear in the accounts again as a financial asset.

Rules.—The new rules, which were approved by the members at the Scarborough meeting, are now in full operation, and have already secured advantages in regard to the admission of new members and in other ways.

Certificates.—The issue of certificates of membership is another advance upon which I can congratulate Mr. Millhouse. It is indisputable that membership of our Association carries with it an appreciable value, and the possession of a certificate will no doubt prove of practical service to our junior members when seeking new engagements.

Regulations for the Prevention of Waste.—This matter, which must closely affect every engineer or manager of a waterworks, has been under careful consideration for several years by a Joint Committee upon which our members, as well as the Association *per se*, are well represented. A new model code of regulations, with detailed specifications for fittings, had been prepared and submitted to the Local Government Board, and is now in progress of revision with a view to its early publication. It is confidently anticipated that, as regards the most vital points, it will be issued under the express sanction of the Board; but as it is desirable to standardize and improve many other matters of detail to which the Board are not prepared at present to give their official sanction under the General Acts of Parliament, it is proposed to publish these in a form which will conduce to uniformity of practice, and the Committee have reason to believe that the Board, as soon as any point has become the basis of common practice throughout the United Kingdom, will be prepared to give it their official and full legal sanction. The Joint Committee have recently appointed the President of the Association for the time being an *ex-officio* member of the Committee; so that I am myself looking forward to taking an active interest in the further work of the Committee, and to seeing the Association even more closely identified with their operations than it has been in the past.

Paris.—The visit to Paris this year will have aroused general interest on the part of members, and the Council are sanguine that not only will valuable experience be obtained as to water-works practice in foreign countries, but that the friendship now existing between the two powerful neighbours, France and England, may be further strengthened by the personal contact of the engineers of both countries who are responsible for the supply of that universal necessity of existence—a pure and ample supply of water.

Unity.—Now, in passing, I should like to emphasize one point on which I feel very strongly—namely, that we should be a thoroughly united body. While some of our members have charge of big water undertakings, supplying extensive districts and large populations, we also have members in charge of small works; but all alike bear heavy responsibilities. In fact, the man in charge of the smaller undertaking often has an even busier time than the engineer of a large concern; being expected to understand not only engineering questions, but the details of plumbing, book-keeping, and many other matters more or less directly connected with his ordinary duties. It is therefore important that when we meet together as an Association, we should freely exchange ideas and experiences, so that mutual sympathies as well as professional knowledge may be extended to the utmost.

Protection of Municipal Officers.—In the present day, when everything is proceeding at high pressure, and municipal officers are compelled to attend conferences of various professional associations like our own in order to keep themselves up to date, I think that the time has arrived when we should take some action as an Association to induce the Local Government Board, by Special Act of Parliament if necessary, to authorize the payment of our expenses as a legitimate charge on our respective undertakings. For some years I have had the honour of working on the Council of the Municipal Officers' Association, now re-established under the name of "The National Association of Local Government Officers," and I can confidently recommend those of our members who are officers of local authorities to support this Association in their efforts to improve the status of local authority officials generally. The Council of our own Association have recently appointed Mr. Pickering and myself as delegates to represent the Water Engineers in conference with the Association of Municipal and County Engineers and other Societies in reference to the payment of expenses of officials in attending conferences of their various professions. The President of the Local Government Board has been approached on the subject, but up to the present with little effect, except that one of the Board's Inspectors surcharged three members of a council for expenses incurred by their delegates sent to a congress similar to the one we are holding to-day.

We engineers, unless we are prepared to pay our own expenses in attending these conferences, are compelled to go on from year to year in the same groove, and neither see nor hear anything beyond the everyday incidents connected with our own work; whereas at meetings of this kind we are brought into contact with other engineers' experience and opinions and have opportunities of visiting works of different design to our own. All this tends not only to our own benefit as engineers, but also to that of the corporations, councils, or directors whom we may serve. I therefore trust that we may ultimately succeed in getting the Act of 1885 repealed; and I ask every member to assist this movement to the utmost of his power.

Prevention of Waste.—Now a few words on the very vital matter of preventible waste. Not one of us, at any rate, would deny that the greatest luxury a city, town, or rural district can possess is a good and sufficient supply of pure water. The effects of a water famine are only too well known to most of us; and while we realize the unique importance of the commodity we supply, it behoves us to take every precaution that it is used, as far as possible, without waste.

I am convinced that in the majority of towns, in this country at least, 25 per cent. of the water delivered to the consumer is wasted. Although many of the methods now adopted for the prevention of waste are fairly efficient, yet at the same time the waste goes on to an alarming extent. Water-meters in the present day are very numerous in design; but the claim of the various makers, that their own type is the best and the most accurate, must be in all cases put to the test of experiment. I have during the past sixteen years carried out a large number of such tests with all kinds of meters, and have found that while the turbine meter has given satisfactory results in some cases, it has proved very unreliable in others. Disc meters are in some instances fairly efficient; but my experience has proved that the best meter for general use is the "positive" or piston meter, more especially in cases where water has to be delivered to high buildings.

An Ancient Profession.—The profession of water engineering is an ancient one, as will be seen by the prints and descriptions thereof (translated from the Latin), which, by the kindness of the Vice-Provost of Eton College, F. Warre Cornish, Esq., M.A., I have been enabled to reproduce in this address. From these it will be seen that as far back as the year 1662, many devices for the utilization of water-power, which are now looked upon as modern, were, at any rate, the sport of inventors. I trust that you will consider these relics of bygone days of sufficient interest to warrant their being brought before you to-day and reproduced in our transactions.

Conclusion.—I fear that this address is rather lacking in subjects of present-day interest; but I felt that, as presidential addresses are not usually open for discussion, it was hardly fair to introduce debatable matter which might on some future occasion be brought forward by members for practical discussion. At the same time I was anxious not to detain you longer than necessary with a function which can only possess a sentimental and academic interest, but rather to direct your attention as quickly as possible to the very interesting papers which have been presented for discussion at this meeting.

At the conclusion of the address,

Mr. H. E. Stilgoe (City Engineer and Surveyor, Birmingham), Vice-President, said he had been called upon to propose a hearty vote of thanks to the President for his address. Might he say, in the first instance, how sorry the members were that the President was not in his usual good state of health, and offer him, on behalf of the members, their sympathy and hope that, within a few days, he would be quite himself again? The Association owed Mr. Sainty a debt of gratitude for his able address. It was exceedingly interesting; and it covered what he (Mr. Stilgoe) looked upon—and he was sure the whole of the members did the same—as the very important points in the uses of the Association. He knew it was usual in addresses to traverse as far as one could the history of water-works and so on; but, year after year, it became more and more difficult to obtain fresh matter in this direction. And when the President had referred to the particular uses of the Association, the good fellowship, and the opportunity for exchange of opinions, he was sure he had touched the springs which appealed to all of them. The members were delighted with the old illustrations and descriptions the President had given them. Had it not been for his research, they would probably never have had an opportunity of possessing copies of these designs and proofs that there was nothing very new in their profession. They now adapted old principles to modern conditions. If they went back 250 years as the President had done, they saw they had many of the ancient principles to guide them, and their duty lay in the improvement of them. He was greatly interested lately in reading Dr. Plot's "History of Oxfordshire," which was published in 1676. In this volume there were some splendid illustrations of water supply; and the pictures that the President had given them were a still further revelation. Towards the conclusion of the address, the President said something about the question of introducing debateable matter in inaugural addresses. If the President would allow him to say so, he had done well in avoiding such matter. The points touched upon covered everything necessary. On behalf of the members, he might say that the request of the President for their support and co-operation would be most cordially conceded. The President would find every mark of loyalty; and speaking for himself as Vice-President, he should do everything he could during the year to assist him. He was certain Mr. Sainty might be fully entrusted with the duty of upholding the dignity and utility of the Association.

Mr. W. Jones (Pontypridd) said it was a great pleasure to him to second the motion. It was generally understood that no prophet received honour in his own country; but the members of the Association acted in a contrary spirit, and liked to honour in their own towns the men of their number who were elected to the presidency, so that those with whom they came in contact in those towns might know how well their Presidents were appreciated by the members. Mr. Sainty had given them a very practical address, and one that was characteristic of him. As a loyal member of the Association, he (Mr. Jones) should do all he could to support the President during the year; and he hoped it would prove not less valuable than the years of his predecessors.

The motion was unanimously agreed to.

The President, in responding, thanked the members heartily for their kindness. The address was not so long as many had been before; but his time had been so taken up with work during the past twelve months that he had not really had time to put it into the form he should like to have done. Had it not been for their worthy Secretary, he did not know that he would have got so far as he had done; and he must thank him for his assistance in this matter. His thanks were also due to Mr. Cornish, the Vice-Provost of Eton College, who had kindly lent him the book of prints from the College Library from which the illustrations in the address were copied.

Election of New Members and Associate Members and Auditors.

The President nominated Mr. H. Preston (Grantham) and Mr. W. Phelps (Shepton Mallet) as Scrutineers. Later on, these gentlemen reported that the following additions had been made to the membership:—

Members.—**Mr. Angelo Bell, of Chester; Mr. A. M. Cobban, of Scunthorpe; Mr. G. T. Derry, of Sutton; Mr. F. J. Dixon, of Harrogate; Mr. A. W. Grace, of Launceston; Mr. T. F. Harvey, of Merthyr Tydfil; Mr. R. H. Haynes, of Newport, Mon.; Mr. G. D. Mackie, of Clydebank; and Mr. Jas. Maden, of King William's Town, Cape Colony.**

Associate-Members.—**Mr. G. N. Brameld, of Chelmsford; Mr. F. E. Cullis, of Midsomer Norton; Mr. F. E. Francis, of Egham; Mr. R. J. Garratt, of Uitenhage, S.A.; Mr. F. Hughes, of Cardiff; Mr. C. H. Roberts, of Birmingham; Mr. C. L. Roberts, of Prestatyn; Mr. J. G. Scott, of Manchester; and Mr. C. G. Woolway, of Cardiff.**

Associates.—**Mr. F. O. Erichsen, of London; Mr. F. E. Howard, of London; and Mr. W. Wood, of London.**

On the proposition of the President, Mr. S. Simmelkjor and Mr. R. E. Middleton were elected Auditors for the ensuing year.

Papers Read.

Thursday.—**"High-Pressure Centrifugal Pumps," by C. J. Dicken.**

Friday.—**"The Detection of Pollution in Underground Waters and Methods of Tracing the Source Thereof," by Dr. J. C. Thresh. "New Water-Works at Milton-next-Sittingbourne," by Messrs. W. Gore and Martin Deacon.**

Saturday.—**"The Scunthorpe Water-Works," by Mr. A. M. Cobban.**

There were good discussions on all the papers; and both the papers and the discussions will in due course be dealt with in the "Journal."

Votes of Thanks.

Before the members rose from their sitting on Saturday,

Mr. W. Millhouse (Scarborough) remarked that the meeting had been held under the most favourable circumstances; and not the least of those circumstances was the convenience the Mayor and Corporation had granted the Association by the use of the Council Chamber for their sittings. He had very great pleasure in proposing a vote of thanks to the Mayor and Corporation for their cordial reception and for the use of the Guildhall.

Mr. G. Greenslade (South Hants Water Company) seconded the motion; and it was carried unanimously.

Mr. T. Molyneux (Stockport) proposed a vote of thanks to the authors of the papers, and other contributors to the proceedings. The members, he remarked, all sympathized with the President in his unsatisfactory state of health, and thanked him heartily for the brave way he had gone through the meeting. His address and the description of the Windsor Water-Works were very useful. Dr. Thresh gave them a most instructive paper; and he was sure it would be very valuable to the members. The members, he thought, would all try to see what they could do by the use of fluoresceine. Mr. Dicken's paper on centrifugal pumps was also a very interesting one. It put before them information about a plant that some of them had never used; and it might help them in future when they had to decide the class of plant they wanted for any particular purpose. He might couple Messrs. Gore and Deacon and Mr. Cobban together. The papers they had presented had involved them, he was sure, in a lot of hard work. The amount of trouble that such papers entailed did not appear on the surface. No one until he had spent time in collating such details could appreciate this. To Mr. Middleton, who with Mr. Walter Hunter had shown the members round the Staines works, they had to express their great indebtedness for his account of the works.

They were works of considerable magnitude; and yet the scheme had been carried out at very reasonable cost.

Mr. ARTHUR ANDREW (Oldham) seconded the motion, remarking that the papers had been equal in every respect to those presented at previous meetings. He was sure they would be exceedingly valuable in their "Transactions" for future reference. It must have entailed a great deal of heavy work on the authors to prepare the papers; and it was only right their hearty thanks should be given to them.

The motion was cordially agreed to.

Mr. F. W. LILLICRAP (Devonport) proposed a vote of thanks to the Council and officers for their services during the year. The whole of the members were well aware of the excellent work they had accomplished.

Mr. A. WELLS (Lewes) seconded the motion, and it was cordially adopted.

The PRESIDENT proposed a hearty vote of thanks to Mr. W. B. Bryan, the Engineer-in-Chief of the Metropolitan Water Board, for the permission kindly accorded to visit the Staines Reservoirs, and to Messrs. Hunter and Middleton for their kindness in being present at the inspection, and for the information they had personally given the members. He might say that as soon as the members elected him to be their President, he at once communicated in writing with Mr. Bryan to ask him if he would allow the Association to visit the works; and, in reply, he received a very nice letter from that gentleman saying that he was most pleased to do anything possible for the benefit of the Association. Then he asked Mr. Middleton if he would prepare a paper on the Staines reservoirs; and he readily complied. The members he was sure were as grateful as the Council were to these three gentlemen.

Mr. C. CLEMESHA SMITH (Wakefield) said that all would agree that the visit to the Staines Reservoirs was one of the features of the meeting. It was not every day they saw water-works of such magnitude and absorbing interest. Mr. Bryan, Mr. Hunter, and Mr. Middleton had laid them under a debt of gratitude; and therefore he was very pleased to second the proposition.

The motion was carried by acclamation.

Mr. J. C. BARROWCLOUGH (Batley) proposed a vote of thanks to the President for the arrangements he had made for the visit to Windsor, both in respect of the business meeting, the entertainment, and the visits. Everything had been all that members could desire. They trusted Mr. Sainty would be immediately restored to health; their great regret was that he would be unable to accompany them on their visit to Paris.

Mr. H. PRESTON (Grantham) seconded the motion. He observed that he knew something of the labour and anxiety, as well as the pleasure, of arranging for meetings of this character; and he also knew that the pleasure given to those who attended was a lasting one. When the labour and anxiety had all been forgotten, they would, and so would their President, still retain in memory the enjoyment derived from the visit. He also wished their President a speedy restoration to health and strength.

The motion was carried with applause.

The PRESIDENT, in the course of his acknowledgment, said he could assure the members it had been a great pleasure to have them at Windsor. He was only sorry he was not in his usual health; but he hoped that, by the winter meeting, he would be in a more robust state, and also that they would have a good meeting on that occasion. He should anticipate it with much interest and pleasure. He warmly thanked the members for their kindness to him.

THE ANNUAL DINNER.

The Annual Dinner was held on Thursday evening, in the Guildhall. There was a good company. The President was in the chair; and the Association were greatly honoured by the presence of Mr. J. Francis Mason, M.P. for Windsor, and His Worship the Mayor. Several members of the Corporation and officials, including the Town Clerk (Mr. E. C. Durant) and the Borough Surveyor (Mr. A. Stickland) were also present. Among other prominent guests were Mr. Walter Hunter and Mr. R. E. Middleton. The evening was one of much enjoyment to all present—not by any means the least of the contributions to that end being the beautiful music provided by the Westminster Singers.

During the evening, the loyal toasts were submitted and enthusiastically honoured. Following them,

Mr. WILLIAM MATTHEWS (Southampton) submitted the toast of the Mayor and Corporation of Windsor. He remarked that, as an Association, they were much indebted to them, as they had been to other municipal bodies, for kindly hospitality. The Windsor Corporation, like so many others in the country, were doing their level-best to carry out, to the best of their ability, the high and honourable duties entrusted to them. They, like others, had no doubt made mistakes. It was not human that mistakes should not be made; and the perfect corporation had not yet been created. It was one of the pleasant experiences of the Association that they had received much help from municipal bodies; and it was very pleasant for the members to be brought into contact with them. He thought that it also did the members of corporations good to be brought into contact with the work of the Association, and learn something of what was being done outside; and in his (Mr. Matthews') estimation, official work was greatly helped by this. He coupled with the toast the name of the Mayor.

The MAYOR thanked Mr. Matthews very much for his kind remarks and the members for heartily endorsing them. The Corporation were very pleased to see members of Associations like this in Windsor. Such Associations ought to be encouraged; for municipal officials had hard and serious work to perform. So far as the Corporation officials of Windsor were concerned, they did remarkably well.

Mr. C. E. JONES (London) submitted the toast of "The Houses of Parliament," coupling with it the name of Mr. J. F. Mason, M.P.

Mr. MASON, M.P., in responding, remarked that, before the dinner, Mr. Jones had told him he had a most supreme contempt for the Houses of Parliament; and he (Mr. Mason) rather fancied he was at present inclined to agree with Mr. Jones. However, he felt it a great honour to be allowed to respond for the Houses of Parliament and also for himself on this occasion. The invitation to be present at the dinner was one which he accepted with extreme pleasure, because it brought him into contact with a body of gentlemen with whom he felt great sympathy—the water engineers of the country. After all, the business which the members of the Association had in hand was, he ventured to think, the most important of all engineering practice in the country, because they dealt with one of the absolute necessities of life. He was himself an engineer—not a water engineer, but a mining engineer; and he ventured to think that engineers of all sorts were more or less drawn together by a common bond. Although a mining expert was not an expert in other engineering branches, he had to deal with a great variety of subjects. He had to deal with heavy and difficult pumping operations, electricity, the provision of houses, and so on; and it was therefore requisite he should have a knowledge of mechanics, electricity, hydraulics, sanitary science, and matters of that sort. It was therefore a pleasure to him to meet so many experts in one branch of engineering science. In his concluding remarks, he said that water supply had entered on a comparatively new stage, in regard to the action animal life had upon waters; and not only had they arrived at the fact that water often contained harmful bacteria, but that it contained organisms which they should not kill.

The MAYOR next proposed "The Association of Water Engineers." In doing so, he said the Corporation were glad the Association had selected Windsor for this year's conference. They recognized that the Association was a valuable one, and that the members of it were working in all parts of the country carrying out great schemes for the benefit of the people generally. Considerable skill was employed in water engineering, in bringing water from hundreds of miles away to their great cities. He did not know that a water famine would not be worse than a bread famine. He therefore thought they had much for which to thank water engineers. He wished the Association every success during the coming year; and he associated with the toast the names of the President and Vice-President.

The PRESIDENT, in reply, said he had personally taken a great interest in the Association from the commencement; and there were many others in the room who were present at the meeting held in Nottingham at which the Association was formed some years ago. He had never entertained the slightest idea that the members would consider him worthy to be elected President of the Association; but he was proud indeed that they had thought so. His chief aim would be during the year to serve, to the best of his ability, the office to which he had been called; and, doing so, would not injure the Corporation in the slightest. He did not neglect his duties for the Association in any way; and he was sure other members did not neglect theirs. The members utilized their leisure time in seeing what they could do to benefit the Association; and what was done was very helpful to each one in the performance of his duties.

Mr. H. STILGOE, the Vice-President, also in reply, said his Worship had remarked that the Association filled a very useful purpose—that of arranging to look after the engineering of that great necessity of life—water. The Association had only been in existence eleven years. It started in a small way; and to-day it numbered nearly 300 members. Apart from the technical work upon which they were immediately engaged, the Association had been recognized by representation on the Joint Committee on Water Regulations; and they were now working hard to get the regulations properly formulated, with the view to arrange for the testing of fittings and standardizing generally. The Association were also represented on the Engineering Standards Committee, who had done a very useful work. There was one work which he should like to see the Association carry out. Though they were young in years, they were strong in numbers, and were distributed all over the country. The late Professor Symons, F.R.S., a few years ago established a system of rainfall records; and he (Mr. Stilgoe) would like to see the Association take up the work of an underground water survey. He had done a certain amount of work himself by taking the levels of the wells in a certain district. If the engineers in various parts of the country would make these records they would be of immense use and interest. They might gauge streams and many of the large springs that flowed to the sea from the chalk. He should like to see this work taken in hand by the Association. There was one other point. It was that the members were pleased to see Mr. Mason present that evening. He (Mr. Stilgoe) hoped when there was any general water legislation before Parliament which affected water engineers that Mr. Mason would remember that the Association were doing good work, and, if there were any inquiries, that he would see that the Association were properly represented.

Mr. MILLHOUSE submitted the toast of "The Visitors." He thought all members must have been struck by what they had seen at Staines

that day—the immense works for supplying London with water for some time to come, by taking the sources furnished by Nature close at hand without going farther afield, and robbing other parts of the country. He had seen many water-works in his time; but the water-works inspected that day had impressed him very much. He must congratulate two gentlemen who were there that evening upon this stupendous piece of work; and he would ask Mr. Middleton and Mr. Hunter to reply to the toast.

Mr. MIDDLETON, in responding, said he would content himself with simply thanking Mr. Millhouse and the members for the way in which they had honoured the toast, and for having associated his name with it.

Mr. HUNTER, in his remarks, said it had given both Mr. Middleton and himself the greatest possible pleasure to see the members at Staines; and they also felt it an honour that the Association had asked them to their banquet. There was one point about water engineering which fell from the Mayor and one which fell from Mr. Millhouse to which he should like to refer. The Mayor said he admired the stupendous works which brought water from hundreds of miles away for the supply of a city; and Mr. Millhouse said he had that day visited works which had utilized the sources of supply found practically upon the spot. He (Mr. Hunter) ventured to think it was not the business of the engineer to make stupendous works unless they were absolutely necessary; he should confine himself principally to the particular features of the place with which he had to deal. When he told those present that, as a matter of fact, the difference in cost between a supplemental supply of water from Wales and obtaining the quantity of water from the Thames for which power was given under the Staines Reservoirs Act meant something like 30 millions sterling to the ratepayers of London, he thought they would agree that this showed that a water engineer, when he came to treat of these problems, must take into consideration chiefly the local circumstances with which he had to deal.

Mr. C. E. JONES submitted the toast of "The President;" and, this having been cordially honoured, the PRESIDENT responded.

On Friday evening, a successful Bohemian Concert was given in the Victoria Hall of the White Hart Hotel. The members and their friends were heartily welcomed by the President, who had made himself responsible for the programme. His generosity was suitably acknowledged, on the proposition of Mr. Easton Devonshire, before the evening terminated.

VISITS TO WORKS AND PLACES OF INTEREST.

A town so rich in interest provided much scope for sight-seeing; but the royal, historical, and beautiful surroundings did not absorb all leisure time. On Thursday and Friday afternoons, the inspection of important water-works were brought into the programme. The visit on Thursday afternoon was to the now celebrated Staines Reservoirs of the Metropolitan Water Board, which have been, among modern engineering works, probably the best patronized, through the kind permission of the authorities, by engineering and other organizations. The route to the reservoirs lay through the royal domains and through the pretty town of Staines; and though the weather was threatening all the time, and rain fell once, the latter was of short duration, and moderate in amount. The itinerary was first to the intake, then to Wraysbury syphon, thence to the pumping-station, and away to the reservoirs. It was expected that at the intake the large party would have been met by Mr. W. B. Bryan, M.Inst.C.E., the Chief Engineer of the Metropolitan Water Board; but Mr. Bryan's engagements, to his regret, prevented him doing so. But Mr. Walter Hunter and Mr. R. E. Middleton, MM.Inst.C.E., were able to keep their appointments; and they accompanied the visitors through their whole drive, and in fact spent the rest of the day with them. Mr. M. B. Duff, who was Resident Engineer at the time the works were in progress, and also a partner in the firm of Messrs. Middleton and Hunter, was there, as was also Mr. I. A. Sparkes, who was an assistant during the construction of the works, and is now the Superintendent. These gentlemen—Mr. Hunter, Mr. Middleton, Mr. Duff, and Mr. Sparkes—mingled with the members, and gave them at each stopping-place all sorts of information connected with the grand monumental example of engineering under inspection. Their kindness was greatly appreciated.

The Staines reservoirs have been described from time to time in the "JOURNAL." But Mr. Middleton had prepared for the visit a special account, which gave much information in succinct form, together with important details as to costs. We extract from the description some of the principal parts.

THE STAINES RESERVOIRS FOR THE WATER SUPPLY OF LONDON.

[Extracts from a Paper by R. E. MIDDLETON, M.Inst.C.E.]

Although the system is known as that of the Staines Reservoirs, it might be more properly described as one to provide storage in the Thames Valley near London; and there is a considerable area between Molesey and Walton-on-Thames on which two reservoirs of smaller capacity have been built, and others will be constructed. These will be more expensive in themselves than reservoirs built at Staines; but, on the other hand, they are nearer London, and cheaper on this account.

At Staines the intention was to construct future reservoirs to hold from 3000 to 5000 million gallons each, and thereby to reduce the cost per million gallons stored. The existing instalment, owing partly to its smaller dimensions and partly to the division into two reservoirs, cost about £170 per million gallons stored; while a reservoir to hold 5000 million gallons of more economical shape could be built for £105 per million.

Intake.—The intake, at which the water is abstracted from the Thames, is situated a short distance above Bell Weir. Just in front of the intake there are fender piles, with top waling and floating booms, to prevent barges being driven upon, and damaging, the works. Inside the fenders are open wrought-iron screens, arranged in semicircular fashion, and behind these fine copper wire screens in duplicate to prevent floating material getting into the aqueduct. The water passes through the intake house, which is divided into four passages about 5 ft. 3 in. wide, each of which is controlled by a sluice gate worked by hydraulic power. The power is supplied by an accumulator, which is pumped up as required by a gas-engine, run by oil-gas made on the site. The gas-engine also pumps water to a tank at the top of the tower of the intake house, from which a supply is drawn for the use of the persons in the cottages and for washing the wire gauze screens. Each division can be shut off for inspection, repairs, and cleansing, and pumped dry by a centrifugal pump actuated by the gas-engine already referred to.

The cost of the intake works, including houses, gas, and hydraulic plant, &c., was about £9830.

Gauges at the Intake.—There are two self-recording gauges in the intake house, one of which shows the quantity of water passing over Penton Hook Gauge Weir, up to 400 million gallons a day, and indicates whether the full quantity of 100 million gallons a day may be passed into the aqueduct, or whether a less quantity is available or the sluices must be closed. The other indicator records the positions of the several sluice gates, the level of the water in the river within the screens, and in the aqueduct, from which data the quantity drawn from the river may be calculated.

Aqueduct.—While the daily supply taken from the river is restricted to 35 million gallons, a further quantity of 65 million gallons may be taken and stored in the reservoirs when the state of the river permits it, and there is space in the reservoirs. Consequently, more water must at times be carried to the pumping-station than thence to Hampton. Two sizes of aqueducts have therefore been adopted. The larger one extends from the intake to the pumping-station, a distance of 3183 yards; the smaller from the reservoirs to Hampton, a distance of 10,819 yards, but connecting with the larger aqueduct, from which it can be shut off by means of a Stoney sluice erected near the pumping-station. The total length of aqueduct is about 8 miles.

The actual requirement of the larger aqueduct is that it should be capable of delivering 100 million gallons a day at the pumping-station, and of the smaller one that its capacity should not be less than 45 million gallons daily—being the quantity which the Local Government Board might authorize. As, however, the works were considered to be an instalment only of a very much larger whole, it was considered desirable to purchase sufficient land for the construction of three aqueducts; the capacity of the larger being 150 million gallons and of the smaller 90 million gallons daily. This was the more justified by the small increase in cost of the larger over the smaller dimensions.

The aqueduct is covered with steel girders for a length of 940 yards. The large aqueduct is 13 feet wide at the springing of the invert, and 15 ft. 10 in. at the coping level, with a depth of water of 6 ft. 4 in., and a total depth of 8 ft. 6 in.—the versed sine of the invert being 15 inches. The small aqueduct is 8 ft. 3 in. wide at the springing of the invert, and 11 feet at the coping level, with a depth of water of 6 ft. 4 in., and a total depth of 8 feet. The versed sine of the invert being 9 inches. The outside dimensions are 18 ft. 6 in. and 13 ft. 9 in. respectively. The invert and side walls are constructed of concrete, covered with 5-8ths inch of cement rendering in the proportion of about 1 of sand to 1 of cement. At every 30 feet there are expansion joints in

the aqueduct, which are composed of brickwork set in asphalte, and have a zig-zag bond with the concrete.

The cost of the aqueducts, with land and contingent works, was about £260,811, or about £24 per yard run.

Pumping-Station.—As already indicated, a quantity of water equal to 65 million gallons may have to be pumped into the reservoirs in a day of 24 hours. To do this five double sets of triple expansion Worthington pumping-engines have been provided at the pumping-station situated near the Billet Bridge at Staines. Each set is capable of pumping 16¼ million gallons per day, so that any four can undertake the whole duty, the fifth being spare.

The lift of the water varies from about 4 feet when the reservoirs are empty to about 43 feet when they are full. Steam is supplied at 150 lbs. pressure by three pairs of Babcock and Wilcox boilers, fitted with the makers' own superheater, each having 1265 square feet of heating surface. Forced draught is provided by a steam-driven fan; and a Green's economizer with 240 pipes has also been supplied. The feed water is pumped from the aqueduct or the pumping-mains according to circumstances.

The engine-house, 108 feet long by 55 feet wide, has been built of white gault bricks relieved with arches, pilasters, &c., of red brick and spandrils of terra-cotta representing the coats of arms of the three Companies who constructed the work and the seal of the Joint Committee. The inside of the building has a high dado of glazed tiles of a delicate lilac shade, which, together with a polished mosaic floor, give a bright and cleanly appearance to the house. An electrically driven travelling crane is provided. The boiler-house corresponds to the engine-house, and is 57 ft. 6 in. long by 48 feet wide. The chimney is circular, 5 feet diameter inside, 100 feet high, and finished with a cast-iron cap.

Detached from the engine and boiler houses there is a house containing a dynamo, which provides current for operating the large travelling crane in the engine-house, lighting both at the pumping-station and the outlet works of the reservoir, as well as affording the necessary power to motor-pumps for emptying the outlet tunnels of the reservoirs when required. Adjoining the dynamo-house there is an engineer's repair shop.

The cost of the pumping machinery, &c., was about £29,118, and of the land and buildings connected therewith about £29,997, which includes the cost of a siding connected to the London and South-Western Railway.

Pumping-Mains.—The water is conveyed from the pumping-station to the reservoirs, a distance of about two-thirds of a mile, through four out of six sluice valves, 2 feet diameter, into steel tubes tapering from 3 ft. to 4 ft. 6 in. in diameter connected to two steel mains each 6 ft. 4 in. in diameter. The metal is ⅜ inch thick, and is coated with "siderosthen" composition inside and outside. The 6 ft. 4 in. mains are laid side by side with a space 2 feet between them; and in order to stiffen and preserve them, they have been surrounded with concrete with a minimum thickness of 6 inches.

At the pumping-station end, the west main has been connected to the central and two northern pumps and the east main to the central and two southern pumps, by which arrangement, no matter what four pumps are being used, a pair may be connected to each of the mains.

At the reservoir end, the two mains join into one pipe, 7 ft. 10½ in. in diameter, which is again divided into two of the same size, one carried through the tunnel leading to the northern reservoir and the other through that leading to the southern reservoir. These pipes are so large that the special branches at the junctions formed quite important pieces of work [see illustration]. In order to give sufficient strength to the flat surfaces which occur at the junction breeches, a girder was built round the pipe transversely to its length, and another girder round the breech connecting above and below with the former girder.

Both at the pumping-station and reservoirs the mains are controlled by valves varying from 24 inches to 36 inches in diameter. Where these valves occur, the mains have been decreased in diameter by means of long, tapering cones, by which the size, and consequently the cost, of the valves has been greatly reduced and their manipulation made more easy, while at the same time only a few inches in loss of head, through additional friction, has been introduced.

At short intervals manholes have been provided for access to each main, so that they may be cleaned out and coated as occasion requires.

The cost of the pumping-mains, including excavations and concrete work, was about £39,585.

Reservoirs and Outlet Works.—The water area of the two large storage reservoirs extends to about 425 acres, and their combined capacity to about 3338 million gallons. The southern reservoir is slightly larger, in area and capacity, than the northern; but the latter has a greater depth. The greatest depth in the southern reservoir is 30 feet, and in the northern reservoir 40 feet; the average depth all over both reservoirs being about 30 feet. The length of the embankments, puddle trenches, and walls is about 4¼ miles.

The trench varies in depth from about 10 feet to 37 feet. It was carried 4 feet into the London clay and carefully filled with puddle prepared in a pug mill. The embankment was formed in 9-inch layers. Provided, therefore, with natural clay bottoms and artificial clay walls, the reservoirs are perfectly watertight.

The puddle wall is 6 feet wide at the top and 7 feet at ground level; batters in to 4 feet wide at 10 feet below ground level; and continues 4 feet wide thence to the foundations. The top of the embankment is 14 feet wide; the outer slope is 2 to 1 and the inner 3 to 1.

To protect the inner slopes from the action of waves, the greatest fetch of which is about 1 mile, concrete protection work has been provided. It is carried down to a line 20 feet vertically below the top of the embankment, or 63 feet measured down the slope. The freeboard is equal to 5 feet measured vertically; so that the protection work extends to 15 feet below top-water level. The foot of the concrete face work butts upon a heavy concrete toe, at the level of which the embankment is widened 3 feet by a berme, below which

Breeches Pipe.

the slope is protected by heavy gravel. The 4 to 1 concrete facing was formed *in situ* in blocks about 4 ft. 3 in. square and 5 inches thick. Every alternate block was first of all laid, and after these had set the others were filled in—a narrow joint being kept between them by means of iron screens which were afterwards drawn out. This work has a first-rate appearance, and, what is more important, it has been eminently efficient. The reservoirs have now been filled for five years, and there is no sign of any deterioration of the face-work, and no expense is incurred in maintaining it.

The cost of the reservoirs, including the small one at Hampton and the land required, has been £571,658.

Measuring Apparatus.—It will be remembered that the water at the intake must pass through one of four sluice doors. Floats have been provided in the river outside and in the aqueduct inside these doors, and the difference of level between them is shown upon a recording diagram. Upon the same diagram the amounts to which each sluice door is open is shown by another line, and by these the quantity of water passing may be calculated. At the steel syphons under the River Colne, light flap doors of sheet brass have been hung on trunnions in such a way that the greater the velocity of the water the more near to the horizontal does the flap become. The movement is transmitted to the recording apparatus placed in a small house overhead; and the diagrams have been calibrated so as to show the amount of water passing.

On each of the pumping-main inlets to the reservoirs

there is a 36-inch Venturi meter, by which all the water pumped into each reservoir is measured; and on each of the outlet mains there is a 24-inch Venturi meter recording the draught on each reservoir. The clockwork and recorders of the four Venturi meters are in a room inside the valve-house, which is built over the outer end of the tunnels.

Another flap door is fixed in the concrete syphon which takes the smaller aqueduct under the London and South Western Railway at its crossing about half-a-mile below the pumping-station. All water, whether direct from the intake or from the reservoirs, must pass this point, so that the total supply sent forward to Hampton is measured here. At Hanworth and Hampton the quantities of water taken are measured and recorded by floating weirs. All these measurements, as well as the depths of water in the aqueduct and reservoirs, are transmitted electrically to the pumping-station, so that the engineer knows the state of affairs all along the line of works.

The cost of the measuring apparatus, including two measuring houses on the aqueduct and three at Hampton, was £12,924.

The following is a summary of the cost of the principal works included in the scheme:—

	£ s. d.	£ s. d.
Intake.		
Plant and Buildings		9,830 0 0
Aqueducts.		
Excavation, 225,300 cub. yds. .	42,136 0 0	
Concrete, 66,200 ,, ,,	71,087 0 0	
Cost, including bridges, &c. .		190,144 0 0
Land required, 145 acres . .	70,667 0 0	
Total cost, including land . .		260,811 0 0
Reservoirs.		
Excavation, 2,696,000 cub. yds.	294,122 0 0	
Puddle, 265,500 ,, ,,	99,557 0 0	
Concrete facing, 186,000 sq. yds.	41,853 0 0	
Cost, excluding land. . . .		470,654 0 0
Or per million galls. capacity .	104 4 0	
Land required, 501 acres . .	101,004 0 0	
Cost, including land. . . .		571,658 0 0
Or per million galls. capacity .	170 6 0	
Cost, including land and inlet and outlet works		614,616 0 0
Or per million galls. capacity .	183 4 0	
Steel Pumping Mains.		
Cased in concrete, including valves, &c., 1667 tons. . .		38,925 0 0
Steel Syphons under Rivers.		
Six in number, 83 tons . . .		4,035 0 0
Pumping-Station buildings, chimney, and workmen's cottages	24,309 0 0	
Land, 88 acres	5,688 0 0	
Total . . .		29,997 0 0
Pumping Machinery		29,118 0 0
Electric Light and Power Installation for lighting pumping-station, buildings, valve well and tunnels at reservoirs, draining tunnels, and working traveller in engine-house		3,254 0 0
Gauging Apparatus, Venturi meters and electric recording gear, including buildings . . .		12,924 0 0

Total amount of steel used . . . . about 2,000 tons.
,, ,, cast iron used . . . ,, 3,000 ,,
,, ,, concrete ,, . . . 122,000 cub. yds.
,, ,, excavation ,, . . . 3,600,000 ,,
Total amount of land acquired, about 734 acres.
Cost, including certain water rights, £198,932.

On Friday afternoon, sight-seeing was resumed. In the first place, a visit was paid to Windsor Castle, where, through the influence of the President, the members had an unusually fine opportunity of inspecting parts of the historic place. From the Castle, the members wended their way to Eton College, where they were charmingly received; and an inspection of the College was made by special permission of the Provost, the Rev. J. J. Hornby, D.D., D.C.L., C.V.O. From the College, the Windsor Corporation Water-Works on Tangier Island were next visited, under the personal guidance of the President and his assistants. The works are beautifully situated; and the visitors lingered long about them—a further temptation being the very acceptable provision made for afternoon tea by the President and Mrs. Sainty. [In view of this visit, the President had prepared a description of the works, from which we extract the more important parts.]

THE WINDSOR WATER-WORKS.

[Extracts from a Description prepared by the President.]

The first part of the paper was historical; and it took the reader down to the time when in 1883 the Windsor Corporation and the Eton Local Board applied for, and obtained, the insertion of a purchase clause in a Bill that was being promoted by the then private owner of the works. Owing to the refusal of the Eton Local Board to join the Corporation in purchasing the undertaking, the Corporation promoted a Bill in the following year providing for the transfer of the undertaking to them instead of relying upon the Act of 1883; and under this later Act (the Windsor Corporation Water Act, 1884), the transfer was ultimately completed—the purchase price being fixed by arbitration. It is perhaps hardly within my province to criticize the decision of the arbitrators; but having been engaged for the past 16 years in an earnest endeavour to make the undertaking self-supporting, I have some grounds for contending that the purchase price was excessive. At least, I may fairly claim that the efficiency of the plant, and the expenses of working, afford but small scope for further improvement of the financial position, and till the annual capital charges are reduced or extinguished by the operation of the sinking fund, no great improvement is possible in this respect.

At the date of transfer, the pumping plant comprised two turbines, an ancient water-wheel operating two pumps, a grasshopper engine operating the three-throw plunger-pumps 6 inches diameter, and an old horizontal high-pressure engine driving three-throw pumps 10 inches diameter.

In the year 1890, the old engines and Cornish boilers were replaced by a compound, jet-condensing Worthington pumping engine (having a stroke of 10 inches, pump plungers 6 inches diameter, capacity 400,000 gallons per 24 hours, lift 250 feet), and a new boiler of the locomotive type.

In the following year, two additional turbine pumps were erected, having a similar capacity to those erected in the year 1873. The water supply again proving insufficient, the Water Committee in 1894 had a boring made from the bottom of one of the wells. This was lined with a 6-inch tube, which was carried to a depth of 135 feet; but though it passed through chalk and flints, no increased supply of water was obtained. It was therefore decided (in May of the same year) to construct a new well to a depth of 28 feet, and of a diameter of 8 feet, passing through the surface gravels into the chalk. This availed for the requirements of the next nine years; but in 1903 a new well was constructed 20 feet internal diameter, and 35 feet deep. This was lined with cast-iron cylinders in segments, planed and jointed perfectly watertight. On testing this with a 6-inch centrifugal pump for 14 consecutive days, the level of the water was lowered less than 2 inches. The suctions of all the pumps were then connected to the new well, and an ample supply of splendid water has been available from this source ever since.

It is worthy of remark that the old well, described by the Company's expert witnesses at the arbitration proceedings as being "inexhaustible," was pumped out within about four years of the transfer of the undertaking to the Corporation. Returning to my chronological record, the steam plant was extended in the year 1899 by the erection of a new steel Cornish boiler, 18 feet long and 5 ft. 6 in. diameter, having a working pressure of 100 lbs. per square inch, and a compound-duplex non-condensing pumping-engine by Messrs. Hayward Tyler and Co., Limited; both being fixed in the house formerly occupied by the old engines.

In the year 1904, a further pumping-engine, also made by Messrs. Hayward Tyler and Co., Limited, but with jet condenser, was erected, and the following description applies to both pumps.

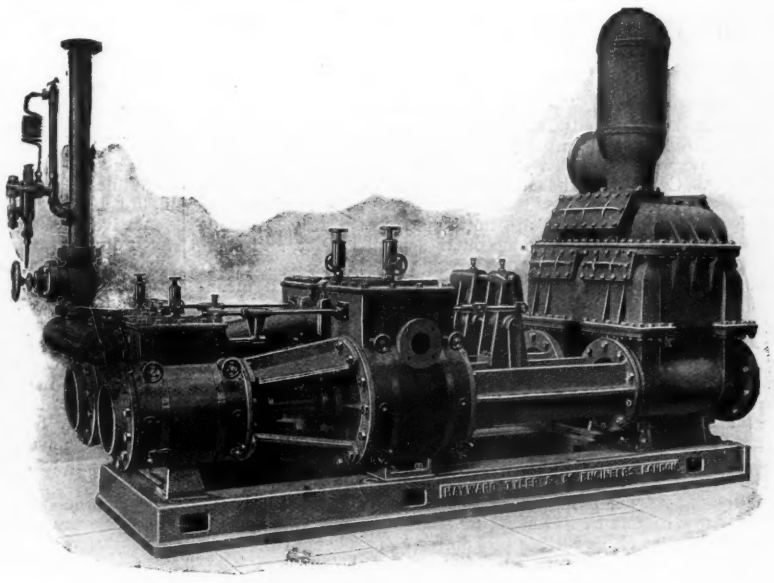
The capacity of each set is 1¼ million gallons per 24 hours, against a head of 200 feet, and with an initial steam-pressure of 90 lbs. per square inch. Steam cylinders 12¼ inches and 19 inches in diameter respectively, with 12-inch stroke. Pump barrels 12 inches diameter, lined with gun-metal. Pump valves of rubber cased with gun-metal, working on gun-metal grids and seats, and controlled by brass springs. Pump buckets packed with cup leathers.

The pump erected in 1899 proved of special value, as during the following year the condition of the river was such that the new pump was in use for a period of five months, working continuously day and night. While the severe trial was passed through without accident or breakdown, it afforded convincing evidence of the necessity for a duplicate

pump; and it was indeed a relief to me, as well as a great safeguard to the consumers, when this was installed three years ago.

Having no service reservoir to balance the daily variations in the demand, the pumps are subjected to unusually severe conditions of working. To maintain an adequate supply during hot weather is also made more than ordinarily difficult owing to the small diameter of many of the older branch mains. As an indication of the development of the district during the period that the undertaking has been in the hands of the Corporation, I may mention that, whereas the length of mains in 1885 was not more than 11 miles, it is at the present time 26 miles. The number of houses now supplied is upwards of 5000, not including two barracks.

The supply to the Dean and Canons of Windsor Castle is through a tank situated in the Canons' Cloisters, at the top of what are known as "The Hundred Steps." This tank is about 90 feet above Thames Street, where the 6-inch supply main branches off. The average daily supply now amounts to 1¼ million gallons.



Hayward Tyler and Co.'s Pumping Engine at Windsor.

On reference to the discussion which followed the reading of my paper in 1902, I find that I was not at that time in a position to reply to a question as to the quantity of water required to operate the turbines. I have since made a point of obtaining this information, and am glad to take this opportunity of recording it for the information of members. When the "fall" or working head is 4 ft. 6 in., the quantity of flow required to keep all the turbines working at their normal speed of 18 revolutions per minute is about 950 gallons per second, or about 77 million gallons per 24 hours for each turbine. The horse power developed by each turbine under these conditions is about 40. The water-wheel requires a flow of 20 million gallons per 24 hours to operate it.

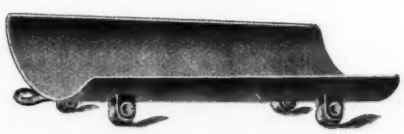
Except for the variations in the "head," due to the operation of the weir-sluices in times of flood, these works are very favourably situated for the use of water power; but from my long experience of this class of motive power, I am of the opinion that undershot water-wheels give better results than turbines.

On Saturday afternoon a visit was paid to the Royal Gardens, Frogmore, which were open for inspection by permission of General Sir Dighton Probyn, V.C., G.C.B.

In the evening, a return was made to London, whence many members at once proceeded to their homes, but not all. A not inconsiderable party is spending this week in Paris, where they are enjoying a very courteous reception, and are being shown some of the special features of the Paris Water-Works. We shall be giving some account of the visit later on.

APPARATUS FOR FACILITATING THE REPAIR OF RETORTS.

A paper was read before the last meeting of the Bavarian Association of Gas and Water Engineers, by Herr Koss, of Eger, in which the author described a cheap and simple apparatus he has designed for facilitating the repair of cracked or broken horizontal retorts. From the report published in the "Journal für Gasbeleuchtung," we derive the following particulars.



The apparatus itself is shown in the accompanying illustration and consists of a cylindrical tray, about 3 feet long, supported on four rollers. In the tray, the workman lies prone or supine according to the position of the repair he has to make; while in one corner of the tray he places the materials he has to use. The author states that the truck can be used with equal satisfaction in either an oval or a ⌂ shaped horizontal retort. It has the advantage of leaving both hands free for work, whereas in ordinary circumstances the man often has to employ one of his hands to support himself in the necessary position. Moreover, owing to the rollers on the tray, the man can move himself backwards and forwards along the retort as he may require. In the absence of such a device as this, it is often found so difficult or so tedious to effect a repair underneath a horizontal retort, or a very large repair in any position, that some gas engineers prefer to set a new retort in the bench instead of attempting to patch the old one. Herr Koss also states that, as the man is supported in the tray at a distance of some 18 inches from the retort, he can remain inside for a considerable period of time even when the plant is fairly hot.

Gas-engines will, the "Engineer" learns, be used in the power plant of the Milwaukee Northern Electric Railway.

London Gas Companies and the Price of Coal.

In our editorial columns last week a paragraph appeared referring to a statement made by the "Investor's Chronicle" as to the effect of the increased cost of coal on the London Gas Companies. It was pointed out that possibly the figure quoted by our contemporary regarding the extra amount the London Gas Companies would have to pay for coal this year was a printer's error. Since then, however, we have learned that the reference should have been to gas companies in the United Kingdom. The figures the writer of the article in the "Investor's Chronicle" had in his mind were 15,000,000 tons for the entire country, instead of about 3,000,000 tons used by the London Companies.

Jubilee of "Le Gaz."

With the current issue, our contemporary "Le Gaz" completes fifty years of existence. It was established in 1857 by M. Emile Durand, who in course of time handed it over to his son, M. Paul Durand, on whose death its management was undertaken by his widow, with the assistance, as Technical Editors, first of M. Jouanne and subsequently of M. Parsy—both well known in French gas engineering circles. The paper was started when the gas industry was beginning to develop in France, and just after the gas supply of Paris had been consolidated under the Company who have recently passed out of existence. In the half century which has elapsed, what great changes have had to be recorded by the technical journalist. Our contemporary's comparatively limited space and the monthly intervals of its publication have necessarily militated somewhat against the fulness of its record of these changes; but under its present Editor the contents have been greatly improved. In a short article, reviewing the progress of "Le Gaz," with which the current number opens, M. Parsy claims that the policy laid down by its founder has never been departed from. "Probity and Independence" has ever been its motto; and in all its dealings, whether personal or technical, this has been constantly kept in view. To this fact, M. Parsy attributes the success which the publication has achieved. He assures his readers that he will endeavour to conduct it on the same lines; and he expresses the hope that those who succeed him will hold firmly the principles with which his predecessors were imbued, and have the gratification of leading "Le Gaz" to its centenary. We cordially add our best wishes for the continued prosperity of our contemporary.

THE CANDLE-POWER VALUE OF DAYLIGHT.

It has been frequently stated that the human eye cannot long bear without fatigue and irritation the direct light rays of any luminous source, if its intrinsic brilliancy exceeds five or six candle power per square inch; and some corroboration of this is found in one's ordinary experience of different means of artificial lighting. Candles, opal-shaded lamps, and most flat flames have intrinsic brilliancies lower than 5-candle power, per square inch of luminous surface, and are not found particularly fatiguing. The direct rays of an oil-lamp or an argand burner, and some frosted incandescent glow lamps having from 4 to 8 candle power brilliancy, are perhaps just bearable. On the other hand, incandescent gas-burners with from 20 to 25 candle power per square inch, enclosed arcs of some 100-candle power, incandescent electric lamps of 200 to 300 candle power, and Nernst "glowers" of probably 1000-candle power, are far above the suggested maximum of 5-candle power per square inch, and require more or less shading to bring them within the physiological capacity of the retina. Obviously, the greater the brilliancy the greater the need for protecting the eye, even if waste of illumination result from the shading. Notwithstanding this fact, further advances in the production of high-power lights will probably be made, finality not having yet been reached. Man may have evolved sufficiently to endure brilliant illumination which would have ruined the eyes of his earliest progenitors. Throughout the ages, however, he has blinked at the direct light of the sun, estimated at 600,000-candle power when at its zenith, and 2000-candle power on the horizon; and even now, in spite of his evolution, the mere reflected sunshine of a bright day is frequently too much for him. Reading and writing in the open air under a dull sky is often no more than he is physically capable of enduring.

The natural light to which the human being has been so long accustomed affords, perhaps, a guide to his requirements in the way of artificial illumination; and Professor O. H. Basquin has recently performed a useful service in bringing before the readers of the "Illuminating Engineer," and indirectly others, some data as to the candle-power value of ordinary daylight. The experiments of which he gives particulars were made in Chicago, and lasted over two years. The light from the zenith sky was chosen for examination, and measured through an opening in the roof over a factory top floor, where the photometer was situated. The opening was 8 or 9 feet above the photometer flicker screen, and the comparison was made with an incandescent lamp sliding on the bar—the lamp being frequently checked against a Hefner standard lamp. The kinds of sky were arbitrarily divided into five classes—viz.: (1) Clouds, no blue sky, no sun, storm present or near. (2) Overcast, no blue. (3) Clouds predominating, principally cumulus. (4) Blue predominating, clouds generally cirrus. (5) Cloudless, either clear blue or hazy. The figures of brightness for each class are given by Professor Basquin in candle power per square foot, rather than per square inch—the unit used for artificial illuminants. The comparative values of day and artificial light can, however, easily be obtained by using the divisor 144 for Professor Basquin's figures.

Three tables are given, showing the monthly mean brightness of the sky at 9 a.m., 12.30 p.m., and 4.30 p.m. respectively. These indicate considerable differences, not merely between the classes, but also in the results obtained at various times of the year and hours of the day. The mean figures, in candles per square foot, of the two years' tests, irrespective of season, for morning, midday, and afternoon, are extracted as under:—

Class.	1.	2.	3.	4.	5
Time.					
9.00 a.m. . . .	180	560	720	485	320
12.30 p.m. . . .	310	960	750	590	460
4.30 ,, . . .	196	620	560	435	310

From these figures it may be seen that the average brightness of the day for each class is as follows: 229, 713, 677, 503, and 363 candles per square foot.

It is curious to note in the full tables that more light was received per unit of area opening in Class 2 with the overcast sky than in Classes 4 and 5, when clouds were practically absent, though it is obvious, as Professor Basquin suggests, that the atmospheres in the latter classes were too clear to allow light to diffuse.

The tables disclose considerable variation in results, dependent upon the period of the year. To take two months only, in the case of the morning tests, the mean figures, irrespective of class, were for January 185 candles and for July 735 candles per square foot. At midday the figures for these two months were 325 and 925 candles, and at 4.30 p.m. 27 and 300 candles per square foot respectively. The contrasts in any one class, however, may be still greater. The author himself draws attention to this when he states that mean observations in Class 2 for December fell below 200 candles, while those for June were above 1200 candles. From the results and tabulated figures, Professor Basquin calculates that the mean annual brightness of the zenith sky at Chicago is about 500 candles per square foot, which nearly agrees with the average of the daily brightness figures of all classes extracted as above.

A curve is drawn showing that the mean brightness for each hour of daylight closely approximates to the curve of sunshine percentage over the same time; and the following equation is given from which the mean hourly brightness of the sky may be calculated from the mean percentage of sunshine for that particular hour: B (mean brightness) = 20 (mean percentage P − 35). A second curve is added indicating a similar relationship between the mean daily brightness of any month and the mean percentage of sunshine for that month; the equation in this case being B = 20 (P − 30).

While Professor Basquin is careful to point out that the above figures have been experimentally obtained for Chicago only, he tentatively assumes that they are of general application. It is accordingly suggested that the average sky brightness of other places may, with the help of the second equation, be deduced from the sunshine records. Thus at Buffalo the percentage of sunshine is stated to be 50; and the equation therefore works out to 400 candles per square foot as the average sky brightness. The author gives from 25 to 30 as the percentage of sunshine for British towns; but, evidently prompted by the inadequacy of the equation in this instance, he remarks that the difference between the British percentage and that obtained in the States may possibly be accounted for by the different types of instruments used in taking the records. His figures for British sunshine are, however, too low.

Dealing with the variations from the average brightness, the writer points out that while at times the brightness may run up to double the average value, it as frequently drops to half; and it is then that the daylight illumination of shops and offices becomes troublesome. He adds that, in view of the latter case, 250 candles per square foot of opening, or half the average figure, may be taken as a safe working sky constant.

The figure of 250 candles per square foot, or (say) 2 candles per square inch, is low compared with that of most of the present day artificial illuminants. The daylight effect, however, is undoubtedly better and to be preferred. As already shown, it is subject to considerable variation according to the weather, the season, and the hour of the day; but its variations are, so to speak, on a low scale, to which the human eye can easily accommodate itself. In any case, it would appear that its greatest intrinsic brilliancy per square inch is not so high as that of an unshaded incandescent gas-burner, and it is much lower than an electric lamp. The virtue of daylight probably consists in the fact that it is even in character, and that what it lacks in intensity per square inch it more than makes up in quantity, Hence the eye is not unduly fatigued or irritated, as it easily may be by some artificial unshaded luminous sources. Dr. Steinmetz, following others in the same strain, drew attention to this in his paper on "Light and Illumination," recently noticed in the "JOURNAL" (*ante*, p. 581). For most high-power lights, indirect rays by concealment or diffusion by globes are of absolute necessity, if the eyesight is to have any consideration. In the case of globes, probably an intrinsic brilliancy of 2 to 3 candles per square inch of surface, leaving out of the question for the time being the physiological effect of colour, will give something in intensity very nearly akin to daylight; and, assuming no great loss of the original candle power is incurred, it should prove satisfactory.

A Naphthalene Blocked Gas-Pipe.

Mr. L. W. Nuttall, the Manager of the Gosport Gas-Works, sends a photograph, showing a 12-inch coal-gas main leading to the purifiers at his works, which has been cut for the purpose

of cleaning. The deposit shown consists of naphthalene, and the area of pipe available for the flow of gas was only 12·3 square inches.

REGISTER OF PATENTS.

High-Pressure Incandescent Gas Lighting.

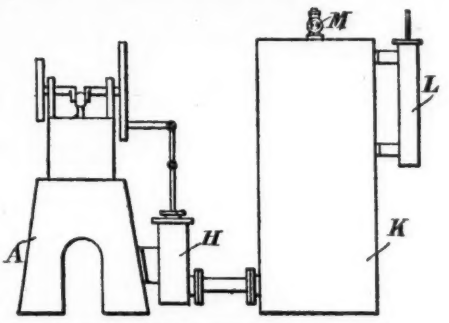
QUETSCH, F. G., of Hamburg.

No. 13,209; June 7, 1906.

This invention relates to high-pressure systems of incandescent gas lighting where compressed air is employed.

These systems of lighting, says the patentee, have several disadvantages—for instance, it is found that, in practice, the theoretical efficiency is not maintained after a short time, and the flame is always accompanied by noise. He attributes this to the water contained in the air drawn from the atmosphere, and the effect of which is enhanced when the air is supplied under pressure. Owing to the humidity, a continuous cooling of the flame is effected, with consequent decrease in light; and then, owing to the water contained in the air supply, oxidation occurs, the supply pipes become contracted, and oxidized metal particles are carried along to the burners and choke them. Finally, "the evaporation of the water in the flame causes a continuous disagreeable hissing noise."

The object of this invention is to avoid all such disadvantages by systematically removing the humidity of the compressed air supply by means of air-drying devices in front of, or behind, the air-compressor. The results attained are "suited to the highest requirements—a light intensity of 2000-candle power and even more can be obtained, and practically all the carbon in the flame is burnt."



Quetsch's High-Pressure Gas Arrangement.

The device for carrying out the invention consists of a hot-air engine A, whose piston movements are transmitted to the piston of the pump H. This, in turn, communicates with the container K, to which the drying device L is connected, and the air-pipe M, which has its outlet at the burner (not shown).

Regenerative Furnaces.

KOPPERS, H., of Essen-Ruhr, Germany.

No. 10,412; May 3, 1906.

Concerning this "process for increasing the economy of the recuperation of heat in gas-fired installations with preliminary heating of the air by the waste heat," the patentee writes in his specification: The principle of the recuperation of heat which is known in connection with furnace systems with gas heating of all kinds—whereby the heating gases and the air required for combustion are preliminarily heated by the heat of the burnt gases which are passing out—is theoretically to be carried out as a complete cycle only when the product of the weight and the specific heat of the media serving for combustion are equal to the product of the corresponding factors of the waste gases. Quite apart from the kind of heat recuperation installations employed, whether so-called regenerators or recuperators, and the greater or less completeness of their construction in practice, a consideration of their efficiency is necessary; and therefore complete recuperation would appear to be impossible. In many cases even the theoretical primary conditions for this are not present.

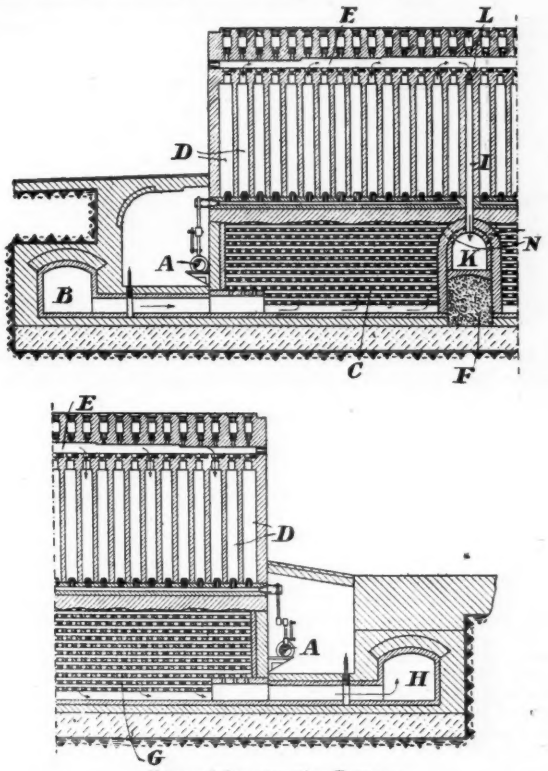
For example, in the case of gas-retort furnaces, only the air is preliminarily heated in recuperators, as the gas is supplied from the generators, which are usually arranged directly beside, or under, the retort-chamber, at the heat at which it leaves the generators. The like case obtains in the employment of heating gas rich in hydrocarbon—for instance, distillation gas in coke-furnaces, as the heating of such gases is not permissible, because they decompose at high temperatures. In such cases it is only possible to preliminarily heat the air.

For the purpose of showing the inefficiency of the heat recuperation installation, which is caused by the essential diversity in the specific heats of the air and the waste gases, when only the air is preliminarily heated, a concrete example is given: For 1 cubic metre of heating gas there flow to the furnace 5·82 kilos. of air, with a specific heat of 0·265 between 0° and 1000°Celsius; while 6·44 kilos. of waste gases, with the specific heat of 0·34, flow off. Taking 1000° Celsius as a departure temperature, there are given up in the heat recuperation installation $6{\cdot}44 \times 1000 \times 0{\cdot}34$ = about 2220 calories per cubic metre of heating gas. On the other hand, the air flowing in, if heated to 1000° Celsius, can only absorb a quantity of heat representing $5{\cdot}82 \times 1000 \times 0{\cdot}265$ = about 1550 calories. For 1 cubic metre of heating gas there is therefore present an excess of heat of $2200 - 1550 = 670$ calories, which escape with the combustion gases. That is to say the combustion gases have a temperature of about 340° Celsius.

Now even if the efficiency of the heat recuperating installation is such that this excess experiences a corresponding diminution, on the other hand the combustion gases must retain a certain temperature in order that they may ascend in the chimney, so that loss is necessarily entailed in this arrangement. Owing to the small difference of temperature, in spite of the large amount of heat, any further utilization of this waste heat—for example, under steam generators—is not possible in practice. That is to say, the amount of heat which is theoretically available is distributed throughout an excessive volume. It is known that large amounts of heat of small degrees of temperature—such, for example, as the heat of the sun—cannot be utilized economically.

The present invention is based upon the broad idea of withdrawing the excess of heat remaining after a recuperation of the heat which has been carried out as completely as possible, at a point in the cycle the temperature of which permits of the further economical utilization of this amount of heat in any known manner. That is to say, before the admission of the waste gases into the heat recuperator where the greatest temperature prevails, a portion is separated and conducted separately as waste heat of high value to a steam generator or the like.

The ratio of the separated amount to the quantity remaining is calculated in such a manner that the latter is just sufficient (having regard to the efficiency) for rationally carrying out the recuperation of the heat, and at the end of the process—that is to say, upon passing to the chimney—to supply a combustion gas which merely presents the minimum temperature required for the ascent of the combustion gases. By this means the economy of the operation of heat recuperation as a whole is said to be brought as close as possible to the ideal.



Koppers' Regenerative Furnace.

The accompanying illustration is merely an explanatory example of a regenerator coke-furnace for utilizing the process, in section along one set of heating flues and through the regenerators arranged beneath the furnace, such as described in patent No. 28,811 of 1904.

The furnace is operated with alternate reversals in the usual manner, and regulated so that the gas entering from the conduit A burns upwards in the flues D with the air entering through the collector passage B, serving as the fresh air-conduit in accordance with the position of its main slide and the regenerator C; while the waste gases are conducted through the upper horizontal passage E into the other half of the furnace. The waste gases descend through the regenerator G, separated from C at the place at which the draught is reversed by the arched passage F, and pass out through the collector passage H, which is arranged as a chimney. With a change of draught, the operation of the regenerators as air heater and waste-heat storer constantly varies.

Now if the dividing wall at the place where the draught is reversed is provided with special passages or flues I, which open into a passage K (separated from the passage F by an arch), a part of the combustion gases—which may be regulated by the adjustment of the slide L—may be withdrawn directly from the passage E as waste heat of high value. The reversal of the draught exerts no influence in any way.

This separate withdrawal may also be effected by placing the regenerators C and G in communication with the waste-heat passage K by means of passages N shown in broken lines. The fact that in this case air passes from the regenerator (which is then acting as the air-heater) into the passage K instead of actual combustion gases (which air has already been highly heated), is said to be without practical importance. This air merely corresponds to an equivalent of waste gases, the heat of which has been transferred to it.

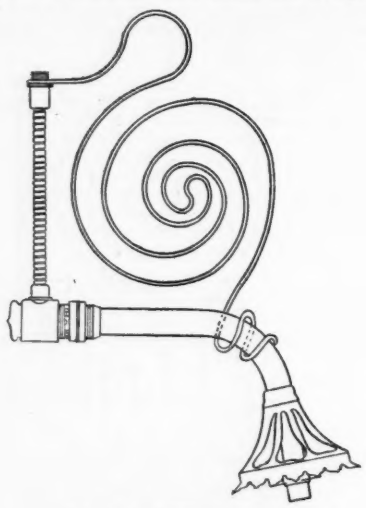
In another connection the manner in which a part of the waste heat is withdrawn at a high temperature is regulated purely by constructional considerations, both in furnaces with separately fitted regenerators of the usual kind and also in furnaces with recuperators. In the case of coke-furnaces, the economy of the process is said to result in a 10 to 14 per cent. better utilization of the steam.

Anti-Vibrators and Gas-Burners.

HELPS, GEORGE, of Nuneaton.

No. 16,754; July 25, 1906.

This invention refers to anti-vibrators for incandescent gas-burners similar to those described in patent No. 2805 of 1905—a combination of flexible metallic tube and wire, or metal tape and the like; the wires being in the form of a spiral calculated to take up any shock the fitting may receive, and so attached to the burner that it, together with the



Helps's Anti-Vibrator Fitting.

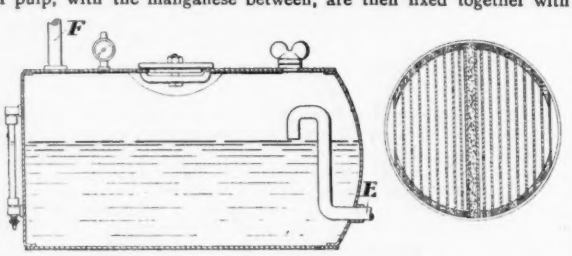
flexible tube, supports it in the desired position. One form the arrangement may take is shown. Here there is a flexible tube, with a wire spiral attached to it and the burner-tube. The fitting is suspended from a screwed connection, and the burner-tube is supported by the flexible vertical tube on which the spiral acts in the place of a counterbalance weight.

Manufacturing Air Gas.

MOORES, W., of Regent Square, W.C., and PETRIDES, G., of Bishopsgate Street Within, E.C.

No. 19,332; Aug. 29, 1906.

For manufacturing air gas for lighting, heating, or power purposes, the patentees propose to make sheets of chemically-prepared wood or other pulp, treated as follows: They first mix together chloride of lime, 14 lbs.; ammonium chloride, 14 lbs.; glycerine, 1 lb.; and hot water, 1 gallon. The wood pulp sheets are immersed in this preparation for about half-an-hour, or until thoroughly saturated. They are then allowed to dry, and, when dry, are dipped in benzoline and again dried. They then take two sheets of this chemically-prepared pulp and insert a layer (2 inches thick) of black oxide of manganese. The sheets of pulp, with the manganese between, are then fixed together with



Moores and Petrides' Air-Gas Apparatus.

copper rivets. The combined sheet should occupy the centre position in the tank shown. On each side of the sheet are placed other single sheets or strips of chemically-prepared wood or other pulp all standing in a perpendicular position and kept apart from each other by pieces of wood. The tank is filled with petroleum spirit (or the like) about two-thirds up. It is provided with an air inlet E and a gas outlet F; the air inlet having a downwardly projecting opening in the tank. The air enters under pressure, and, acting upon the body of liquid, takes up the oil vapour in "an efficient manner" before passing through the outlet to the burners.

The patentees say that, with the arrangement described, they "are able to retain the quality of the petroleum or other spirit in any form, and to produce gas for light, heat, and power of a more lasting and efficient nature than by any other means," and by the use of chloride of lime, they are able to purify the gas in the same way as coal-gas manufacturers do by using silicate of lime.

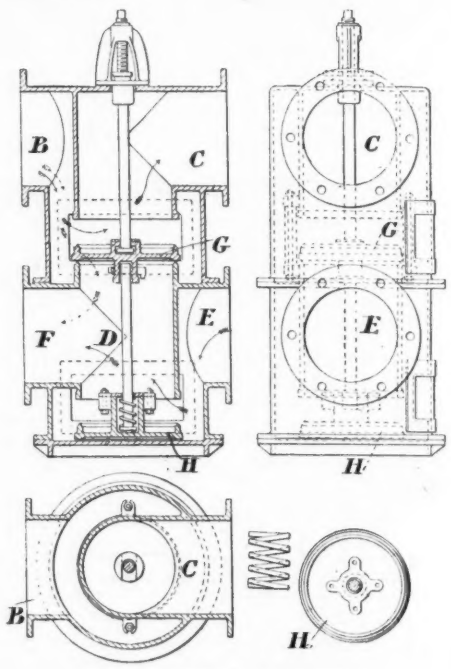
Controlling and Directing the Passage of Gas.

MILBOURNE, R. J., of Muxton, near Newport, Salop.

No. 16,911; July 26, 1906.

This invention is more especially intended for use in controlling and directing the passage of gas into and out of gas scrubbers, washers, purifiers, &c., and for bye-passing such apparatus, when required; and for the purposes of description, the arrangement is presumed to be employed in connection with a scrubber.

A valve casing is provided into which the inlet and outlet for gas to and from the main and the inlet and outlet for gas to and from the scrubber open in such a manner that they can be controlled by valves which can be simultaneously operated by one spindle, so that (presuming the valve to be in the position in which the scrubber is bye-passed) by operating the spindle in one direction passage for gas from the main through the valve casing to the scrubber and passage for gas from the scrubber through the valve to the main are first simultaneously opened, and then the bye-pass opening through the valve is closed; then afterwards, by operating the spindle in the reverse direction, when the scrubber is to be bye-passed, the bye-pass through the valve is first opened and the passages to and from the scrubber are closed, the bye-pass remaining open.



Milbourne's Valvular Arrangement.

The illustrations show a vertical section of the arrangement, a front elevation, a horizontal section, a plan of the lower disc, and a spring (hereafter referred to).

The valve-casing is divided into two parts, and has opening into its upper division an inlet B from the main, and also an elbow passage C opening into the scrubber. Beneath this is a tubular piece D opening at the top into the upper division of the casing and at bottom into the lower division, into which latter also opens a passage E from the scrubber. To the side of D is connected a branch F leading back to the main. The openings of the passage C and of the tubular piece D are in line; and a disc-valve G is situated between the opening of C and the upper of the openings in D, and between the lower of the openings of D and the bottom of the valve casing is another disc-valve H. These disc-valves are connected by a spindle capable of being moved longitudinally—preferably by providing the upper end with a screw working in a screw nut in a saddle-piece outside the casing; the spindle being preferably made in two lengths, the lower end of the upper length being provided with a head engaging (so as to be rotatable) in a recess in, or hollow boss on, the upper disc-valve, and confined therein by a plate; while a head on the lower end of the lower length of the spindle similarly engages with a recess or hollow boss on the lower disc-valve, and similarly confined by a plate.

When the gas is to be passed through the scrubber, the valve spindle is screwed down; the valves first leaving all the passages open. Then the upper disc-valve G closes the upper opening of the tubular piece D, and the lower disc-valve H leaves the lower opening free. Thus the upper and lower parts of the valve-casing are shut off from communication with each other—the gas passing from the main through the upper division of the valve-casing into the scrubber, and from the scrubber through the lower division to the main, as indicated by the full arrows. When the scrubber is to be bye-passed, the valve-spindle is screwed up. Thus all the passages are first left free. Then the lower disc-valve H closes the lower opening of D, and the upper disc-valve G closes the lower opening of C, so that communication with the scrubber is cut off. The gas then passes from the main through D and back to the main, as indicated by the dotted arrows—the passage-way through the valve-casing forming practically a continuation of the main.

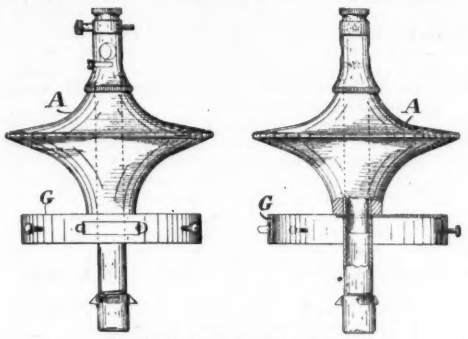
The patentee prefers to provide the spindle of the valves with a yielding device to compensate for wear and for expansion and contraction, or irregularities in fitting. This can conveniently consist of a coiled spring (shown separately) surrounding the part of the lower portion of the spindle just above its lower head, and contained in the hollow boss on the lower disc-valve, and bearing on the head of the lower portion of the valve-spindle and on the closure of the hollow boss (shown in the separate plan of the valve). The length of the lower part of the spindle is such that, when the disc-valve H comes into contact with its seat, the upper part of the other disc-valve G will be a little distance from its seat, and a further turning of the valve-spindle will compress the spring and bring the disc-valve also to its seat.

Vertical Inverted Incandescent Gas-Burners.

BRAY, J. W. & A., of Leeds.

No. 4401; Feb. 22, 1907.

This type of burner is so made that the deflector (composed preferably of porcelain) may also form a reflector, and be accessible for cleansing purposes without the necessity of removing the globe.



Bray's Vertical Inverted Burner.

The deflector A, instead of projecting below the gallery or globe-holder G, is placed above it, and is formed cone-shaped, both above and below its greatest diameter. Thus the surface of the deflector is readily accessible for cleansing purposes without removing the globe. It is provided with an extra wide flange, which also acts as a reflector, and "thus tends to diffuse the light from the burner more equally than is usual in burners of this description"—the flange being in diameter (preferably) equal to, or larger than, the diameter of the gallery.

The deflector is provided with a central bunsen tube, to which is attached the air-admission chamber and gas-nipple and a regulating screw of the type described in patents No. 15,729 of 1903 and No. 16,766 of 1906. The gallery is attached to the bunsen tube by means of a bar or the like attached below the base of the deflector and reflector.

APPLICATIONS FOR LETTERS PATENT.

12,199.—WALLER, W. G., and DICKINSON, E. G., "Combined gas-cooker, gas fire, and water-heater." May 27.

12,224.—NOTT, G., "Gas-valves." May 27.

12,230.—MALDEN, W. J. & A., "Treatment of tars and pitches to render them more suitable for industrial purposes." May 27.

12,260.—RHODE, H. A., "Combination lamp for electric or gas light, or both together." May 27.

12,263.—CHUTTER, G. F., and SALMON, WHITFIELD, AND COLLET, LTD., "Gasholders for producer plants." May 28.

12,348.—BAYLISS, A. J., "Dust-interceptor for inverted burners." May 28.

12,354.—TURNER, F., and HANDS, G., "Incandescent burners." May 28.

12,357.—SMITH, H. E., "Gas-burners." May 28.

12,359.—SEFTON-JONES, H., "Gas-burners." (A communication from the International Marine Signalling Company, Limited.) May 28.

12,501.—GRIFFIN, S., "Gas-engines." May 30.

12,504.—SIMMANCE, J. F., and ABADY, J., "Indicating the level of liquids." May 30.

12,542.—WENTWORTH, J., "Hydraulic gas-mains." May 30.

12,619.—BONNIKSEN, B., and BERRIDGE, T., "Automatic gas lighting and extinguishing apparatus." May 31.

12,639.—BRAMLEY-MOORE, S., "Liquid meter." May 31.

12,661.—KIRKHAM, HULETT, AND CHANDLER, LTD., and HERSEY, S., "Gas-condensers." May 31.

12,716.—SPERRYN, G. N., and SPERRYN AND CO., LTD., "Gas-fittings." June 1.

12,736.—DOSSETTER, W. J., "Supporting mantles." June 1.

12,751.—DOHERTY, H. L., "Washing and cooling gas." June 1.

Fenton Urban District Council Gas-Works.

The report of the Fenton Urban District Council Gas Committee for the past financial year states that the make of gas was 92,102,000 cubic feet—being an increase of 4,840,000 cubic feet, or 5·5 per cent. The unaccounted-for gas was 8·06 per cent.—an increase of 0·16 per cent. for the year. Gas-rentals show a decrease of £713 from private consumers; and there is an increase of £18 from stove-rents. This is accounted for by the reduced price of gas. The increased amount of rebates, compared with the corresponding period of last year, was £1417. The residuals account shows an increase of £184. Repairs and maintenance of works, &c., figure at £947, due to the re-setting of the retorts, re-tubing of the condenser, and the erection of a water-tube condenser and tar-tower. During the year, 118 new services for private lighting, and 173 for gas-cookers, were laid. There was a total increase in the number of consumers of 159. The number of cookers shows an increase of 67 for the year. The whole of the gas for public lighting was given free of charge; and this was equal to an amount of £1249, or a rate of 3·82d. in the pound on the general district rate. The gross profit was £4565; and after paying interest and instalments of principal on loans, there is a net profit of £1392 for division.

Reduction in Price at Meltham.—The Meltham Urban District Council have decided that the price of gas for lighting purposes shall be reduced from 3s. 1d. to 2s. 11d. per 1000 cubic feet, and for trade purposes from 2s. 5d. to 2s. 4d.; such reductions to take effect as from April 1 last.

PARLIAMENTARY INTELLIGENCE.

BIRKENHEAD CORPORATION WATER BILL.

House of Lords Committee.—Friday, May 3.

(*Before Lord* NEWTON, *Chairman, the Earl of* NORTHBROOK, *Viscount* HAMPDEN, *Lord* DE MAULEY, *and Lord* RAVENSWORTH.)

The consideration of this Bill, which is to empower the Corporation of Birkenhead to obtain a supply of water from the Rivers Alwen and Brenig, in Denbighshire, was commenced to-day.

Mr. BALFOUR BROWNE, K.C., the Hon. J. D. FITZGERALD, K.C., and Mr. GERALD FITZGERALD appeared for the promoters. The Bill was opposed, among others, by the Liverpool Corporation, represented by Mr. WEDDERBURN, K.C., and Mr. J. E. EVES; the London and North-Western and Great Western Railway Companies by Sir RALPH LITTLER, K.C., Mr. MOON, K.C., and Mr. GULLEY; the Chester Corporation, by Mr. HONORATUS LLOYD, K.C., and Mr. CLEASE; the Chester Water Company, by Mr. MOON, Mr. FORBES LANKESTER, K.C., and Mr. GAMMON; the Wirral Rural District Council, by Mr. SQUAREY; the Wirral Water and West Cheshire Water Companies, by Mr. TALBOT, K.C.; and the Connah's Quay Gas and Water Company, by Mr. CHARTERIS.

Mr. BALFOUR BROWNE, in opening the case, gave an interesting historical sketch of Birkenhead, and then traced the development of the borough in recent years. He said it now covered an area of 3850 acres, and had a population of 117,203 and a rateable value of £630,000. In 1858, the Corporation purchased the gas and water undertaking for £220,000. The water was obtained from five wells in the red sandstone in the Wirral Peninsula. In 1859, the Wirral Water Company was established, and Oxton and Bebington were within its limits of supply. In 1881, Birkenhead negotiated for the purchase of the Company's undertaking, but without success. Negotiations were renewed in 1896; but the price asked was considered excessive. Accordingly, Rock Ferry and Oxton, though inside the borough, were still supplied by the Company. This was a grievance, because the price charged was equal to 1s. 6½d. in the pound, compared with 10d. in the pound charged by the Corporation. Within the limits of supply of the Corporation the consumption of water per head of the population was about 32 gallons a day, of which 10¾ gallons were used for trade purposes, and the quantity was rapidly increasing. Last year the quantity of water pumped from the Corporation's wells was equal to 3,627,413 gallons a day. The Corporation made a small profit last year—£3129—out of the water, equal to a rate of about 1½d. in the pound. They did not, however, propose in future to make any profit out of the water; whatever profits there were would go in reduction of the price. The total quantity pumped last year was 1300 million gallons. But, unfortunately, the level of the water in the red sandstone had gone down, and they had consequently been obliged to enlarge their wells. They were, however, advised that this could not go on, because they had drained all, and more than all, the water that fell on the surface, and were now drawing upon the store in the new red sandstone. The time had, therefore, come when they must seek other sources of water. The position of Birkenhead, even with regard to its present supply, was perilous. The Wirral Peninsula had 36 miles of coastline, and water could not be safely drawn very materially below sea level. If they kept above this, they only got the rainfall; if they went below it, after a time the sea water would come in. Liverpool formerly drew its water from the red sandstone, but found its wells deteriorating, and had to undertake the great Vyrnwy scheme. The deterioration of the water in the wells was not only a warning to Birkenhead, but they feared that one or two of them might give out suddenly. It was therefore necessary that the Corporation should have an independent gravitation scheme; and they proposed, as had been done in the case of the Thirlmere and Vyrnwy schemes, to supply water on reasonable terms on either side of their new aqueduct. The Corporation had already entered into agreements with Ruthin, Holywell, and other Local Authorities, to supply water to the extent of something like 500,000 gallons a day. Before embarking on this scheme, the Corporation had approached Liverpool with a view to getting a supply of the Vyrnwy water; and negotiations went on from March, 1903, down to August last. Various schemes were discussed, but they came to nothing. Even after the present scheme had been approved of, they again approached Liverpool to see whether or not they would give a permanent supply; but the Corporation refused to entertain the proposal. Therefore Birkenhead had to come to Parliament with the scheme contained in the Bill. The Alwen reservoir would drain an area of 6500 acres; it would be 2½ miles long, running up the valley; and it would hold 2100 million gallons. From this point the aqueduct would be 41½ miles long to Birkenhead; and from the Alwen they would get 7 million gallons a day. The Brenig drained an area of 5000 acres. The reservoir there would be about 2 miles long, would contain 1700 million gallons, and yield 5,900,000 gallons a day. At Glan Alwen, one earthen dam would be constructed for the purpose of giving compensation water to the stream. The other two dams would be used to carry the water to Birkenhead, because of their great elevation. This was such that the water would flow by gravitation the whole way to Birkenhead without any expensive works. There would be only one small tunnel cut through the top of a hill between two watersheds at Bwlch. The aqueduct would be formed of iron pipes, and the valleys would be crossed by steel ones. At certain places, there were to be balancing-tanks. The cost for the first 7 million gallons would be £740,000, or £105,700 per million; while for the second instalment from Brenig the cost would be £91,000 per million; and the total for 14 million gallons a day would be £1,749,000. The cost to the consumer in Birkenhead would be increased for eighteen or twenty years by about 5o per cent., or 5d. in the pound. But the people were prepared to pay 1s. 3d., instead of 10d., especially as they would get good water, and would be able to increase the trades of the town to a large extent. Even these increased charges were lower than those made by many large towns.

If they were able to arrange to give supplies *en route*, this would, of course, to some extent relieve the burden upon Birkenhead. They asked that during construction the sinking fund should be suspended. The proposed pipe would run right through the Wirral Peninsula, and the Corporation were willing to supply it. Under the scheme, they would get enough water to supply all the neighbouring districts as well as their own increased population for a long time to come. But though they were willing to supply both Wirral and Chester, they were not going into these districts without the full consent—indeed, without the invitation—of the existing authorities. Before proceeding to deal with the petitions, the learned Counsel referred to a report made as far back as 1846 by the late Mr. Thomas Hawksley, who said that when the population of Birkenhead reached 80,000 it would be found necessary to seek a further supply of water among the Welsh mountains. The petitions against the Bill formed a bulky volume; but a large number of them had already been withdrawn, or were in course of being disposed of by negotiation. All the Cheshire County Council now asked was that the Corporation should be under some compulsion to give a water supply to district within 20 miles of the aqueduct. Birkenhead were, however, not prepared to go further than Liverpool had gone in this matter. They would supply if they had the water; but if they had not, then Birkenhead had the first claim. The Corporation of Chester disputed the right of the promoters to take the water from the Welsh rivers. Dealing with the petition of the Chester Water Company, who submitted that the proposed works and the impounding of the waters would have a most serious and damaging effect upon the volume and purity of the waters of the Dee, Counsel argued that impounding could not pollute the water. As to the contention that the Bill would enable the Corporation to embark on a commercial undertaking for the sale of water, Counsel repeated that they would supply no water *en route* unless they were invited to do so, and then only if the water was not required for Birkenhead. Coming next to the petition of the Liverpool Corporation, he said the fact that the proposed line would cross the Wallasey main in five places presented no engineering difficulty that could not be arranged in a few minutes. The Liverpool petition was really one of the smallest on record. Their objection was that Birkenhead would have the right to supply water within an area already assigned by Parliament to Liverpool. This meant that many places within 20 miles of the proposed pipe-line were also within 20 miles of the Vyrnwy aqueduct. But what harm would that be to Liverpool? He was told that Liverpool, being on a lower level, could not supply some places that Birkenhead could supply. But, in any case, why should the localities which were within 20 miles of both pipe-lines not have the chance of taking their supply from either? Besides, Liverpool could not supply in perpetuity. Any agreement might be determined at the end of five years. Birkenhead, on the other hand, in the agreements already made, had undertaken to give a supply in perpetuity; and it was important that these places should have such a supply. Having referred to petitions presented by the Dee Conservancy and the Dee Fishery Board, Counsel turned to the petitions of the Railway Companies. He said the Bill proposed to repeal the agreement between the London and North-Western Railway Company and the Corporation, made in 1857, and confirmed under the Act of 1881. By it, the Company had been supplied with water at the rate of 8d. per 1000 gallons up to 1 million gallons, and 6d. per 1000 gallons above this quantity. The agreement was entered into when the quantity of water taken was small. Now, however, the supply had reached 66 million gallons a year; and it was essential, in the public interest, that the agreement should end, and that the Company, if they required the water, should obtain it on the same terms as other people. In 1861, they took 1½ million gallons; but in 1906 they had 66 million gallons, supplied at 6d. per 1000 gallons, as compared with 8½d. charged to ordinary traders. This was scarcely fair to the latter. The difference to the Company represented £687, and in five years the Corporation might be said to have given a gratuitous supply which represented £3000. Referring to the petitions of the Wirral Water Company and the Connah's Quay Gas and Water Company, Counsel said the object of the Corporation was to supply local authorities; and no competition with water companies would be sanctioned by the Bill.

Evidence was then given on behalf of the promoters.

Alderman *H. Bloor*, examined by Mr. J. D. FITZGERALD, said he had been a member of the Water Committee of the Birkenhead Corporation for about twenty years, and during the past seventeen years had been its Chairman. Speaking generally, during the last fifteen or twenty years his experience had been that there had been a diminution of the water supply, and they had been obliged to deepen existing wells. The making of two new wells cost between £30,000 and £40,000. After all their efforts to improve the supply, it was found that they were not left with much margin between their immediate and their estimated requirements. Population and trade were increasing, and the demand for water for both purposes was going up. Their total domestic consumption was now 23·16 gallons per head per day, and the total for trade purposes 10·76 gallons. In 1881, the quantity for trade purposes was only 4·63 gallons; the present figures showing an increase of about 150 per cent. There was also a tendency for the domestic supply to increase; baths being much more common in houses than formerly. In 1890, the domestic supply was 15·86 gallons per head; whereas now it was 23·16 gallons. Witness went on to detail the steps taken by the Corporation to find a supply. They considered the advisability of sinking more wells, and also getting a supply from Manchester and Liverpool; but they were met with the difficulty that Liverpool was not in a position to furnish a permanent supply, and the terms proposed were of a very onerous character. At the same time, their Engineer was instructed to look out for a supply by gravitation yielding 6 million gallons a day, with the possibility of increasing it to 10 millions. The scheme now proposed was submitted to them, and spoken of in high approval by the experts consulted. Witness explained that it was impossible for the Corporation to accept a temporary supply for a limited period, as offered by Liverpool; and in these circumstances there was nothing for them to do but to go on with the scheme for obtaining water from Wales.

In cross-examination by Sir R. LITTLER, witness acknowledged that the proposed abolition of the limit of charge for water for railway purposes would make a great difference; but he said that the 6d. per 1000 gallons paid by the Railway Companies was, in his opinion, a very low figure. When asked how it was the Corporation had bound themselves to supply rural districts along the route at this price, he explained that, in order to serve the Railway Companies, they had to carry the water three times the distance, in addition to bearing the cost of distribution.

Cross-examined by Mr. MOON, witness said that the present average consumption of the borough was 3½ million gallons per day; but they expected that by 1942 they would require the full 7 million gallons provided by the first part of their scheme. The difference of 25 per cent. was assumed on account of the increase of population and of the consumption to 41 gallons per head per day. The basis for his suggestion as to the 41 gallons per head, in place of 33 gallons as at present, was a great increase in trade demands.

In answer to Mr. HONORATUS LLOYD, witness said he considered the scheme before the Committee was a more economical one than that proposed by Liverpool. He admitted that for the first five years the supply from Liverpool would cost less; but as years went on the Corporation's scheme would be much the cheaper. The capital cost of the first part of the scheme would be £748,000, and of the entire scheme £1,750,000. According to estimates they would want the money for the second part of the scheme in 1940, as they anticipated the water would be required in 1942, and the balance for the third part of the scheme would be required in 1975.

Mr. HONORATUS LLOYD: Are you really seriously asking their lordships to allow you now money powers to the extent of £1,750,000 which may not be required until the year 2000?

Witness: The third part may not be wanted till then; but the first part is wanted now. The second part of the scheme is estimated to carry us on to 1975, when the quantity of water we shall then have available will be about 18 million gallons.

So that if you succeed, you will keep everyone out of this water for something like three-quarters of a century?—We should have to begin the construction of the third reservoir before 1975.

Mr. WEDDERBURN pointed out that the proposed main for the Birkenhead supply passed through districts which Liverpool had a right to supply. He called special attention to the Wirral Peninsula, the whole of which, he said, was in close proximity to the Liverpool main; and he asked if there was any reason why Birkenhead should come and compete with Liverpool.

In reply, witness said their primary object was not competition with Liverpool. What they wanted was to get water for Birkenhead; and if other people were willing to take a supply *en route*, they were willing to furnish it.

Replying to the Chairman, Mr. WEDDERBURN said he would have no objection to the promoters supplying people within a reasonable radius of their main.

In re-examination by Mr. FITZGERALD, witness said it was not their intention to become merchants of water. With regard to the agreement with the North-Western Railway Company, it was made fifty or sixty years ago, and in altered circumstances. He saw nothing improper in now asking Parliament to review it. As a matter of fact, they had been supplying the Railway Companies, if not under, at least very nearly at, cost price; and if this scheme were sanctioned, they would be prepared to give the Companies a very much better service than they had at present.

Monday, May 6.

On the resumption of the proceedings this morning,

Mr. *George F. Deacon*, the Engineer of the scheme, was called. He stated that the present water supply of Birkenhead was lessening in quantity and deteriorating in quality. Taking a broad view of the condition of the whole of the Wirral Peninsula, he was of opinion that it was quite impossible that either Birkenhead or the rest of the peninsula could provide for a future supply of water. The analysis of that drawn from the Birkenhead wells, from the earliest days to the present, showed a sensible increase of salt, which was only what he would expect from the peculiar position. He had come to the conclusion that very soon a large quantity of water must be provided from outside; and he thought it reasonable that provision should be made in the present scheme to meet the needs of districts which geographically might be supposed to have a claim. Alluding to the progress of Birkenhead, witness said that, in addition to the growth of the residential population that had been going on for the past twenty years, there was now a large increase in the manufacturing population of the town as the result of the development of the land along the shore of the Mersey for industrial purposes. Even at the present rate of progress, he estimated that twenty-four years hence the population of Birkenhead would be 207,000, and that it would require a daily water supply of 8,665,000 gallons. Taking the whole of the peninsula, he estimated that in 1944 it would require 23,495,000 gallons a day. Having regard to these figures, he thought Birkenhead ought to contemplate a scheme which would give at least 14 or 15 million gallons a day. Witness then proceeded to explain the area and the engineering features of the scheme. He said the length of the aqueduct was 31½ miles. The Alwen area had an available capacity of 2140 million gallons. This was the reservoir which it was intended to construct in the first instance; and the water area was 330 acres. The drainage area of the Alwen was 6313 acres, and the rainfall 52 inches. This would give a yield of 10,802,000 gallons a day. But one-fourth of the quantity would be set aside for compensation water, which would be discharged continuously in all seasons. This would give an available supply for Birkenhead of 8,102,000 gallons; but the first part of the aqueduct would only take 7 millions. When it was required, they would construct the second part of the aqueduct, which would supply another 7 millions. This would keep up the Brenig reservoir, which had an available capacity of 1544 million gallons, a water area of 255 acres, a drainage area of 4997 acres, and a rainfall of 49 inches. This reservoir would yield 7,807,000 gallons daily. But one-fourth would go as compensation water; so that the quantity available for Birkenhead would be 5,855,000 gallons. The supply from the two reservoirs would thus amount practically to 14 million gallons a day. The construction of the reservoirs did not present any great engineering

difficulties. They were, in fact, remarkable in point of facility for construction; and consequent on their altitude, the water would be carried to Birkenhead by gravitation. The Glan Alwen reservoir, which was at a lower level, and from which water could not go to Birkenhead, would be used to supply the compensation water. It had a water area of 120 acres, a drainage area of 5106 acres, a rainfall of 45 inches, and an available capacity of 1190 million gallons. The available capacity of the whole system was, therefore, 4874 million gallons, a water area of 715 acres, a drainage area of 16,416 acres, and a mean rainfall of 48·9 inches. The estimate for the first instalment, consisting of the Alwen reservoir and one line of pipes, was £758,252. The cost per million gallons was £108,322—an exceedingly low figure. The second instalment, from the Brenig, would come to £576,182, or £82,213 per million; and the third instalment, £415,566, or £7232 per million. These estimates were ample; and unless there was a very extraordinary increase in the price of iron within the next ten years, he believed the works would be carried out for less. He made a comparison between the cost of obtaining water by pumping and the cost under his scheme; and he estimated that in 1917 the sum saved on pumping would be £12,000 per annum, assuming the quantity required to be 5 million gallons. He estimated the interest on capital for the scheme at £28,200, and the £12,000 saved in pumping would go to its reduction. Assuming the quantity required to be 7 million gallons, the cost of pumping would be £18,800. Thus the stoppage of pumping would be equivalent to two-thirds of the amount of interest the ratepayers would have to pay under the scheme. Referring to Liverpool's allegation that Birkenhead would be encroaching on their preserves *en route*, witness said that a little healthy competition would be a good thing for both. Birkenhead wanted to be in an analogous position to Liverpool. The Corporation were willing to accept the powers assigned to them; but they were not particularly desirous of supplying other people.

The CHAIRMAN: The daily consumption in the Birkenhead area is 3 or 4 million gallons. I want to know on what ground Birkenhead ought to be supplied with 14 or 15 million gallons a day.

Replying to the question, witness said that in the first place the present water was not acceptable. It was so hard and objectionable that people would not take it except by compulsion. He thought 14 million gallons would not be too much to look forward to; certainly not, having regard to the experiences of Liverpool, Manchester, and other places. In 44 years, assuming that no water was required outside the present limit of Birkenhead, the quantity needed would be 8,665,000 gallons a day, which would exceed that available from the first reservoir.

In the course of the witness's cross-examination, he stated that the existing wells at Birkenhead were perishing, and the new scheme was the cheapest they could get. Asked if the promoters were suggesting that the increase of the population would be more rapid in the future than it had been in the past, that they should want 8,665,000 gallons in 44 years, witness said the increase was put at the minimum. His scheme was to abandon the wells altogether, except perhaps one. It was not desirable for Birkenhead for many years to have a dual supply. The proposed aqueduct would be made of steel, as this material lasted certainly longer than 100 years without paint or preservative.

Tuesday, May 7.

Mr. *Deacon* was further cross-examined this morning. In answer to Mr. HONORATUS LLOYD, on behalf of the Chester Corporation, witness said he had taken into consideration the probable increase in the quantity of water required for trade purposes in Birkenhead; at present it was nearly 11 gallons per head. His estimate of the consumption of Birkenhead 44 years hence was based upon the population being 207,000, and the total quantity required daily being 42 gallons per head. The water supply of Chester was taken from the Dee, 1½ miles above the weir. As an engineer, he did not like water supplies taken from tidal rivers, and it was obvious that the Chester Corporation should keep a careful watch upon its present supply. In times of drought, the compensation water under the scheme would meet any objection as to injury to the Dee.

In answer to Mr. WEDDERBURN, witness said it was not the object of Birkenhead to get more water than they wanted, and then find a market for the surplus. In 35 years, Liverpool would require a supply of 42 million gallons; and this being so, the Corporation must not go outside their present obligations, and seek to supply districts as far distant from their pipe-line as Birkenhead.

Mr. WEDDERBURN: Assuming that Liverpool has power to supply the Wirral Peninsula, do you suggest that you should be put in a position to come in and make our expenditure unproductive?

Witness: No. The pipe-line was laid for the purpose of supplying Wallasey. I think Birkenhead is the proper centre from which to supply the peninsula.

Do you think it a fair thing, Liverpool having expended a great deal of money before your scheme was thought of, and being now in a position to supply water in the Wirral Peninsula, that you should come in and take the district from us?—I am not proposing such a thing.

Mr. TALBOT (for the Wirral Water Company) intimated that, inasmuch as the Corporation of Birkenhead had disclaimed any intention of competing or interfering with the Company in any way, he did not propose to cross-examine the witness.

The CHAIRMAN: When a corporation are promoting a big Bill of this kind, what is the period of time which they usually seek to cover?

Witness: Birmingham looked forward to being relieved of the necessity of promoting another scheme for forty or fifty years, Liverpool for forty years, and Manchester for a longer period.

For how long would this scheme clear you, supposing you got your entire Bill?—It is difficult to answer. Sooner or later, if Birkenhead makes the proposed aqueduct, it will be called upon to supply other places besides its own district. Taking this into consideration, I think that in between forty or fifty years Birkenhead will certainly need the Brenig supply, and might require to get rid of the obligation to give compensation water from the Alwen and the Brenig.

Suppose only a portion of the scheme was authorized, for how long would that clear you?—Birkenhead will probably require a great deal more than the supply from the Alwen alone in thirty-four years. If only half the scheme were carried out, the Corporation would long before that time have to come for other powers. I feel sure that the Alwen will have run out long before thirty years are past. The want of water in the Hundred of Wirral, by reason of its physical conditions, will become a very serious matter in the next twenty years, and a supply must be obtained from some such source as this.

Sir *Alexander Binnie* was the next witness. He said he had been acquainted with Birkenhead since 1861. The demand for water both for domestic and trade purposes had increased considerably within the last ten or fifteen years; the increase in regard to the former being due more especially to the improved sanitary arrangements which were enforced. In a case like that of Birkenhead, where the water was not only hard but was derived from wells undoubtedly showing signs of contamination with sea water, a change was necessary.

Mr. BALFOUR BROWNE interposed at this point, and said that it had been mentioned to him that some questions were addressed to Mr. Deacon with regard to the three different parts of his scheme. He gathered that the Committee thought some part of the scheme would not be required for the moment, but for the distant future, and that it might be possible to postpone one portion, and pass the Bill as it stood. If this was in their Lordships' minds, he would have no objection, on the part of the Birkenhead Corporation, to withdraw the part of the scheme which referred to Glan Alwen. At the same time, the Corporation thought the time would come when the demands of Birkenhead and the Wirral Peninsula would be so great that they would have to come to Parliament again.

The CHAIRMAN suggested that some question might be put on this point; and if the Committee thought it advisable, they might later on clear the room and get the views of the members.

Proceeding with his evidence, witness said he had been consulted with respect to the scheme for the past eighteen months, and, speaking generally, he quite approved of it. The Corporation were utilizing the watershed to the best advantage. With softer and better water, there was bound to be an enormous increase in the demand.

Mr. *G. H. Hill* expressed the opinion that the scheme for two reservoirs was a very moderate one.

Mr. POLLOCK: What is the saving on the estimate by not constructing the third reservoir?

Witness: I do not know.

Mr. FITZGERALD: The saving will be £415,000 in round figures, I understand.

Mr. POLLOCK (to witness): Do you suggest that both lines of pipes should be constructed, or only one?

Witness: One; the second could be constructed afterwards, when more water was required.

Mr. *Charles Hawkesley* agreed generally with the evidence of the previous witness, stating that the scheme in regard to the two reservoirs was a reasonable and moderate one. He did not think that fifty years was too far to look forward to in a case like Birkenhead. He considered 11 gallons a head of undesirable water was a fairly large quantity for trade purposes; but with a softer water, the consumption would be increased considerably. Witness did not agree that the 14 million gallons would not be required until the year 2014, when the estimated population would amount to 240,313, as suggested.

At this juncture the room was cleared while the Committee considered the question of the third reservoir. On the public being re-admitted,

The CHAIRMAN said the Committee were of opinion that, in the event of the Bill being allowed to proceed, the scheme should be limited to the Alwen and Brenig reservoirs.

Mr. FITZGERALD said the evidence would be restricted to the petition of the Dee Conservancy Board; and he proposed to recall the witnesses in regard to this petition.

Sir *A. Binnie* and Mr. *Hill* agreed that the River Dee would not be injured by the scheme.

Mr. *Hawkesley* said that under the revised scheme the area sought to be drained was only 1-38th of the whole of the drainage area of the Dee, and the water to be taken by the Corporation, when the two reservoirs were constructed and the compensation water discharged, was only 1-53rd part of the entire flow over the weir at Chester.

Wednesday, May 8.

At the opening of the proceedings to-day,

Mr. FITZGERALD informed the Committee that the opposition of all the landowners had been settled. The only outstanding question was the amount of land to be acquired from one of them; and this would be arranged between the Engineers. As regards the fishery question, the Board of Agriculture and Fisheries had had the matter under consideration, and had framed a set of clauses and amendments for insertion in the Bill, in accordance with an arrangement arrived at with representatives of the promoters. On this being done, their petition would be withdrawn.

Mr. *A. C. Hurtzig*, the Consulting Engineer to the Ribble Navigation, and partner with Sir Benjamin Baker, agreed with the previous engineering witnesses that the proposed abstraction of water from the Dee by the works contemplated in the Bill was insignificant—in fact, quite negligible. The Corporation were asking to withdraw only 1-53rd part of the total flow of the river.

Replying to Mr. CHARTERIS (for the Dee Conservancy), witness said he agreed generally with the proposition that if the whole of the land water were excluded from a river such as the Dee, the estuary would silt up; but he could not accept the learned Counsel's suggestion that it was 1-28th, and not 1-53rd part of the total flow that would be abstracted by the Birkenhead Corporation's proposals.

The CHAIRMAN asked whether, in these cases of abstraction arising from the construction of reservoirs, there was any machinery by which Water Boards or Conservators could obtain compensation automatically.

Mr. CHARTERIS said there was not. It was left in the hands of Parliament in each case.

The CHAIRMAN: Would not it be possible to arrive at a settlement on these lines? Is there no public department that could, so to speak, arbitrate between the parties?

Mr. FITZGERALD replied that there was not. It was the ordinary

practice of Parliament to give back as compensation water a certain proportion of the quantity proposed to be taken.

The CHAIRMAN said he understood that; but he said it was an extremely intricate and difficult point for inexperienced members of a Committee to decide. How were they to know how much the Conservators were entitled to have as compensation? He should have thought it would have been much more satisfactory for the parties to submit the question to arbitration.

Mr. FITZGERALD said he saw what was in the mind of the Committee; and if the Conservators would talk the matter over with the representatives of the Corporation, it might facilitate matters.

Professor *Boyd Dawkins* was the next witness. He stated that the sites of the reservoirs were well chosen, and that the works would be carried out at less cost than was usual. The drainage area of the Dee was so large, and the quantity of water impounded so small comparatively, that the effect on the estuary would be practically infinitesimal. On the other hand, the sending down of the compensation water would be beneficial. He corroborated the evidence already given as to the deterioration of the wells.

Dr. *H. R. Mill*, the President of the Royal Meteorological Society, said he had visited the proposed gathering-ground in the valleys of the Alwen and Brenig. The general effect of his evidence was that the rainfall on the ground was not greater than in other portions of the Dee Valley.

Sir *Thomas Stevenson* stated that he had analyzed the water from the Birkenhead wells. It was becoming more saline, and it contained more chloride; and he anticipated that the process would continue and be accelerated. The water was undergoing deterioration, most probably because the wells were receiving sea water. The water was being pumped below Ordnance datum. Asked whether, if the level was not further lowered, and less water was pumped, there was any reason why Birkenhead should not continue to draw (say) 2 or 3 million gallons a day from the wells, witness replied that he could not say. He did not know whether, if they reduced the quantity, the water would rise above Ordnance datum.

The CHAIRMAN said the Committee were satisfied that the water now available for Birkenhead was of a somewhat inferior description.

Mr. *T. Sumner*, the Borough Treasurer, presented tabulated information as to the financial arrangements under the scheme. He said it had been distinctly pointed out to the ratepayers that the scheme would involve a considerable increase in the charges for water; and it was understood the highest rate for domestic supply would be 1s. 4½d. in the pound, and for trade purposes 1s. 1½d. per 1000 gallons.

In reply to Mr. MOON (for the Dee Fishery Board), witness said he could not state how much revenue was expected to be derived from the sale of water outside the district. His calculations were made before any agreements had been arrived at between the Corporation and the Local Authorities on the route of the aqueduct. He had never estimated, as had been suggested, that the sums received for surplus water would be equal to at least 2d. in the pound. He had made no estimate at all of that kind.

At a subsequent stage of the inquiry,

Mr. FITZGERALD announced that the promoters had arrived at an agreement with the Corporation of Chester.

Mr. HONORATUS LLOYD said the object the Chester Corporation had in view was to protect the water consumers. Though they were not the suppliers of water, they had felt that the proposals of the Birkenhead Corporation were likely to jeopardize the existing supplies; and they were therefore most anxious, if they could not succeed in protecting the supply, to secure that they should have an alternative supply for Chester. They had been able to arrange terms with Birkenhead by which, if their Lordships thought right to pass the Bill, if the water supply was jeopardized, Chester would have an opportunity of getting a compulsory supply from Birkenhead.

Mr. FITZGERALD gave details of the agreement. It specified that Chester could at any time within ten years of the supply from the Alwen to Birkenhead commencing, give seven years' notice to Birkenhead demanding a supply not exceeding 3 million gallons and not being less than 1½ million gallons a day; Birkenhead to give such supply in consideration of the payment by Chester of an amount which would bear to the total cost of the works proposed by the Bill for the time being the same proportion that the quantity of water taken by Chester bore to the total capacity of the works for the time being—any difference to be settled by arbitration. Chester was to lay the main at their own expense, and take the water in bulk at the junction of the main with the Birkenhead aqueduct.

This closed the case for the promoters; and the opposition of the Dee Conservancy Board was proceeded with.

Mr. *A. C. Williams*, the Engineer to the Board, was the first witness. He said the navigable channel of the river was deeper by 1 ft. 6 in. to 2 feet at the end of the winter than in the summer. He attributed this to the increase of land water flowing down during the winter months. It was undesirable, and even dangerous, to the future of the river if more water should be abstracted from it. He disagreed with the suggestion that the water to be taken was only 1-53rd part of the entire flow over the weir. He said it would amount to 1-28th, which would reduce the flow at the weir by 6 inches. With regard to the compensation water, the area proposed was too small, and the water was quite useless for the purposes of navigation. He contended that the suggestion to supply water on the line of the aqueduct was a hardship on those who had prior claims upon the Dee. He did not think the proposed steel pipe laid in sand would last very long. The proper thing would have been to put it in a tunnel, similar to the case of the Mersey. Basing his calculations on the figure he had given of 1-28th part of the flow abstracted, he stated that 12,500 cubic yards of sand would have to be removed in consequence of the impounding of the water by the promoters; and this would necessarily entail very heavy expenditure. Witness contended that it was contrary to public policy that the Birkenhead Corporation should go into this watershed and take away such a quantity of water devoted to other purposes.

In cross-examination by Mr. FITZGERALD, witness said the cost of dredging the River Dee was 1s. 6d. per yard. He had heard of it costing only 4d. per yard; but this would be impossible in the case of the Dee.

Mr. *Charles Stevenson* stated that from Chester to Connah's Quay the Conservators relied entirely for scouring purposes on the flood water from the uplands; and if this were taken away, the effect on the navigable channel would be decidedly detrimental.

Mr. FITZGERALD said the promoters admitted that if they took away the whole of the flood water, silting would result; but their contention was that what they proposed to draw off would have no appreciable effect on the channel of the river.

In further examination, witness said the proposed compensation water would have no beneficial effect on the Dee as a navigation river. Constant flow of water would be of no use; what was wanted was floods.

Mr. FITZGERALD questioned witness as to the improvement proposals of the Conservancy Board, and asked how much they would cost. The reply was £380,000; but witness added that they had not been commenced.

Thursday, May 9.

On the re-assembling of the Committee this morning,

Mr. CHARTERIS, on behalf of the Dee Fishery Board, intimated that clauses acceptable to both parties had been agreed upon, and that the opposition of the Board would accordingly be withdrawn.

Mr. POLLOCK, on behalf of the Dee Conservancy, said he proposed to call the Chairman to give information as to the present and prospective traffic on the river, and one or two large traders having works on its banks.

The CHAIRMAN said it might save time if he intimated that the Committee had considered the case of the Conservancy, and had come to the conclusion that, in the event of the Bill passing, they would insist upon compensation being made to the Conservators. He suggested that the matter might be settled by arbitration, and that the parties might find some means of determining the basis.

After some conversation, it was decided that the Conservators' case should be reserved; and the Committee proceeded to consider the opposition of the Wirral Rural District Council.

Mr. *F. E. Priest*, the Engineer to the Council, examined by Mr. SQUAREY, said the Council opposed the Bill because, having spent a large amount on sewerage, they were apprehensive that in the future the difficulty and expense of making sewers would be increased. The district was at present supplied with water by three Companies, and the Council had no desire to interfere with the existing arrangements. But they asked the Committee to say that, in the event of these Companies ceasing to give a supply, they should be in a position to demand it from Birkenhead. They did not wish in any way to interfere with the provision in the Bill which enabled the Water Committee to take a supply in bulk from Birkenhead.

In cross-examination by Mr. FITZGERALD, witness said Wirral was on the Dee, and Birkenhead was taking water from the watershed of the river. As Wirral was within the drainage area, it had an equal right with anybody else in the watershed. On Counsel putting it to the witness that, if the scheme were passed, the Wirral Council would be in a position to ask Birkenhead to give them a supply of water, he replied that they would only be in the same position as Birkenhead was in regard to Liverpool.

Mr. SQUAREY said he was prepared to leave his case where it had been put by the witness.

Mr. MOON then opened the case on behalf of the Chester Water Company. He submitted that the water supplied by the Company at the present time was absolutely pure, both chemically and bacteriologically. But water taken from a river required very vigilant watching; and therefore they were interested in seeing that nothing was done that would interfere with the purity of their supply. The Bill would affect the water of the Dee in three ways. It would considerably diminish the quantity; it would prevent to some extent the remedial action which had taken place hitherto under the influence of the floods which had come down and scoured the river; and if the volume of the water was diminished, the tidal influence would go farther up the river than it did at present. The Chester Corporation would now have the right to get water from Birkenhead; but so long as the Company supplied pure water, the Corporation could not supply in competition with them. If, however, as a result of the action by Birkenhead, they were unable to supply pure water, then the Corporation of Chester could come in and compete, and the Company would be ruined. He contended that Birkenhead was not entitled to go to the Dee watershed, so long as they could get water from Liverpool at a reasonable price, and with a fair prospect of the supply continuing for a sufficient number of years. But if water could not be obtained from any other source, the Corporation should be allowed to take as little as possible from the Dee. Counsel proceeded to direct his opposition specifically to the construction of the Brenig reservoir, and, contending that the needs of Birkenhead had been exaggerated, said that on a liberal estimate the Alwen would provide sufficient water for the requirements of the borough for the next 44 years. Why should the Committee take a leap in the dark, and hypothecate this water to Birkenhead, notwithstanding all that might take place in the way of development in the next half century? If the necessity arose at the end of that period, let the Corporation come for a further supply; but he asked the Committee to say now that they should not have any more water than was necessary for the next 34 years according to Mr. Deacon, but 44 years as he contended, and that therefore the Brenig reservoir must go. Otherwise, the temptation to get the extra supply for the purpose of making money out of it would be so great that the water would be sold to communities altogether outside the watershed, to the serious injury of the Dee in respect of the interest of the Chester Water Company. As to the compensation water, the Shropshire Union Canal Company appeared to be able to take as much water from the Dee as they required for their purpose; and he supposed they would continue to do so, and would absorb the extra water sent down by the Birkenhead Corporation. But, in any event, and whether or not the Committee determined that the promoters were to have both the Alwen and the Brenig reservoirs, his contention was that one-fourth compensation water was not enough, and that it ought to be one-third.

Mr. TALBOT, on behalf of the Wirral and West Cheshire Water Companies, asked the Committee for a clause in the Bill providing

that no supply should be given within the districts allotted to these Companies, except by way of a bulk supply to them.

Mr. CHARTERIS, addressing the Committee for the Connah's Quay Gas and Water Company, brought forward a clause, the effect of which was to put upon the Birkenhead Corporation an obligation to give the Company a supply of their surplus water at such a price as might be fixed in the Bill. He said that the Company did not wish, in the event of their requiring a supply of water, and not being able to obtain it from any other source, to be obliged to accept just such terms as the Birkenhead Corporation might seek to impose upon them. There was nothing in the Bill which would secure to the Connah's Quay Company a supply of water on reasonable terms.

The CHAIRMAN asked how, in such a case as this, the price was determined.

Mr. CHARTERIS said it was was generally a matter of agreement. His clients could not compel the Birkenhead Corporation to give them water at a reasonable price.

The CHAIRMAN asked if there was anything to prevent a corporation who were supplying water outside their own district charging whatever they pleased.

Mr. FITZGERALD replied that it was entirely a question of agreement. They had to regulate the price by the demand. It was obviously to the interest of Birkenhead to sell on reasonable terms, if they wished to enter into an agreement.

It was announced that an arrangement had been come to with the London and North-Western and Great Western Railway Companies, and that their opposition would be more conveniently dealt with when clauses were under consideration.

Mr. WEDDERBURN then addressed the Committee on behalf of the Corporation of Liverpool. Having alluded to the exceptional position of the city as regarded their capacity to supply water, he said that, as to the economy of the present proposal, he could not help thinking that if the interests of the people of Birkenhead were to be considered, the Committee would think it desirable that the Bill should not proceed. Recalling the agreement that had been entered into between the Corporations of Liverpool and Manchester as to competition in regard to the districts served by the Vyrnwy and Thirlmere aqueducts, Counsel said the whole question was whether Liverpool should not be dealt with in exactly the same way as against Birkenhead. Parliament said, by its approval of the agreement, that there must be no competition between Liverpool and Manchester; and it was clear that there must be none between Birkenhead and Liverpool. If it were otherwise, there would be a perpetual cause of doubt and interference. The real question which the Committee would have to determine was what was a fair dividing-line to make between the Birkenhead and Liverpool aqueducts, within which areas the two Corporations would have the power to supply without competition from the other. Liverpool had laid down its second pipe, at a cost of some £600,000, on the basis, as Mr. Deacon had admitted, that it would be a productive main. Surely, when a statutory position had once been given to the Corporation, and money had been expended on the faith of it, Parliament was not going to do anything to prejudice that position. This applied not only to the Vrynwy aqueduct, but also to the Wallasey one; so that on both of these lines—no distinction whatever could be drawn between them—he was entitled to have his position uninterfered with within a reasonable distance. Liverpool must be reasonable; they must not adopt a "dog-in-the-manger" policy, and seek to prevent Birkenhead supplying those whom Liverpool could not supply. Birkenhead's position was certainly a peculiar one. From each of the reservoirs they proposed to get 7 million gallons; and they had already, by the different bargains they had made in order to settle the opposition, given away half their supply. So that Birkenhead must keep the Alwen reservoir for themselves, and must make the Brenig reservoir in order to supply other people. It was for the Committee to say whether this was a reasonable position to take up. The proposition he had to make was this: Let Birkenhead supply anyone who was absolutely in their line; but they must not come to the south side of the Liverpool main. This left to be determined the debateable ground between the two mains; and what he proposed was that Birkenhead should have power to supply within 5 miles of their main, but that they must not come into those 5 miles if it brought them within 5 miles of the Liverpool main. A dividing line must be drawn; and if what he had suggested was not fair, let it be extended to 6 miles. But, in any case, seeing that Liverpool had got their pipe through the whole of the Wirral Peninsula, he asked the Committee to say that there should be no competition there—that this part of the district should remain open to the supply of Liverpool, and not to a competitive supply from Birkenhead.

Alderman *Burgess*, the Chairman of the Water Committee of the Liverpool Corporation, was then called, and in answer to Mr. WEDDERBURN said the Corporation objected to any clause which would allow the Birkenhead Corporation to compete with Liverpool in their own area as regarded water supply. They claimed the whole district within 20 miles of their main; but they would be willing to make some arrangement by which south of the Dee Birkenhead could supply any district within 5 miles of their main, so long as it did not come within 5 miles of the Liverpool main. Liverpool claimed the whole of the Wirral Peninsula excepting the borough of Birkenhead. They were supplying Wallasey under an agreement; and if Birkenhead were to get their Bill, Wallasey might give Liverpool five years' notice and take their water from Birkenhead. The main would then become useless. Liverpool, in all its agreements, had reserved the right to terminate the contract with five years' notice; but there was no likelihood of their failing to continue the supply.

Mr. WEDDERBURN said the Water Engineer to the Corporation (Mr. Joseph Parry, M.Inst.C.E.) was present to give evidence, if necessary; but it would only be confirmatory of Alderman Burgess.

As neither the Committee nor Mr. Fitzgerald desired further evidence, the case against the Bill closed.

Mr. FITZGERALD then replied on behalf of the promoters. He pointed out that the evidence showed that Birkenhead undoubtedly required a further supply of water. They had examined every likely scheme, and the one they were putting forward would give an admirable supply in every respect. It was both sufficient in quantity and first-rate in quality. The opposition had dwindled down to practically none at all. The suggestion that the scheme would be detrimental to the River Dee was without foundation. The compensation water would increase the dry-weather flow by nearly four times the normal amount, and would therefore improve the river at a time when it was most needed. With regard to the Liverpool opposition, he was perfectly willing to accept the limitation of 5 miles, leaving the Wirral Peninsula common ground. He was not so unreasonable as to suggest that Liverpool, after laying a main to Wallasey, should be prevented from continuing the supply; but it was entirely unreasonable to suggest that if anyone in the Peninsula wanted a supply of water and could get it from Birkenhead, the Birkenhead Corporation should be precluded from giving it. Counsel said he understood that an arrangement would be made with regard to the Dee Conservancy Board's compensation.

The room was then cleared. After a few minutes' deliberation by the Committee, the public were re-admitted.

The CHAIRMAN said the decision of the Committee was that the preamble of the Bill had been proved; but they considered that the amount of compensation water ought to be raised from one-quarter to one-third. With regard to the Liverpool opposition, they accepted the proposal made by Mr. Fitzgerald, which left the Wirral Peninsula common ground. They thought that where the promoters asked for power to supply water in bulk in outside districts, there ought to be some limit fixed to the charge; and they suggested that this should be 10 per cent. higher than was paid by the persons supplied in the promoters' own area. The other points would be dealt with when the Committee considered clauses.

Monday, May 13.

To-day the Committee considered the clauses of the Bill.

Mr. J. D. FITZGERALD explained that an arrangement had been arrived at with the London and North-Western and Great Western Railway Companies, and that an agreed clause would be introduced. In accordance with the decision of the Committee, an amendment had been made in the Bill, providing that one-third of the water impounded, instead of one-fourth as originally suggested, should be discharged into the streams as compensation water. They proposed to give effect to the view of the Committee that, where the promoters were asked by outside authorities to furnish a supply of water in bulk, the charge ought to be limited, by a clause providing "that the price to be charged by the Corporation for a supply in bulk to any council or other local authority or water company, shall be such sum per 1000 gallons as shall not exceed by more than 10 per cent. the average sum payable per 1000 gallons to the Corporation for a supply within the borough of Birkenhead." They had so amended clause 27 as to limit their supply to any council or other local authority, or to any company or person, any part of whose district or premises was situated within five miles of the aqueduct. This, of course, would be subject to the obligations they had already undertaken in the case of Chester and Holywell, which were a little beyond the five miles.

The CHAIRMAN: Where does Wirral come in?

Mr. FITZGERALD said the Liverpool offer was not to supply an area of 5 miles on one side of the Birkenhead pipe-line. But the promoters felt great difficulty in putting anything of this sort into the Bill, because it might affect the rights of third parties, and questions might on this account be raised by the authorities of the House. Accordingly, as they did not attach any very considerable importance to Liverpool not supplying within 5 miles of the Birkenhead pipe-line, they did not propose to incorporate in the Bill that part of the Liverpool offer; and it was not necessary to say anything specially about the Wirral Peninsula. The understanding was that this should be common ground; and therefore the rights of Liverpool there would remain untouched.

Mr. CHARTERIS, on behalf of the Connah's Quay Gas and Water Company, argued that the new clause with regard to the price at which water was to be supplied to outside authorities wholly failed to give effect to the Committee's decision. The Committee had indicated that the sum charged should be 10 per cent. higher than was paid by consumers in Birkenhead. This protection was intended to benefit outside water authorities like the Company he represented, who might ask the Corporation for a supply; and in order to make the protection effective, they must consider the questions of price and of compulsion. In fixing the price, the Committee should have regard to the cost of the water to Birkenhead, and secure that the Corporation should receive a reasonable profit on the amount expended in bringing the water from the gathering-ground. The Connah's Quay Company were at present supplying water at a very low price, and yet were able to earn their maximum dividend. It was therefore not on the Company, but on the consumer, that the consequences would fall if the Committee fixed such an exorbitant price as Birkenhead was, by the clause, asking the outside authorities to pay. The effect would be to hamper the development of the district. By the clause they had proposed, the Corporation sought to charge his Company not only a portion of the cost of bringing the water past their premises, but also of its distribution in Birkenhead. This would entail on Connah's Quay a cost of something like 1s. 3d. per 1000 gallons, whereas the cost of the present supply was 6d. The thing had only to be stated to show its absurdity. The only rational basis was the cost to Birkenhead of supplying water to the Company; and they were willing to agree that it should be the expense of conveying the water to Birkenhead *plus* 10 per cent. But if the cost of distribution in Birkenhead was to be taken into account in arriving at a basis of price, the clause was worthless, and did no carry out the decision of the Committee.

The CHAIRMAN: It might conceivably be cheaper for you to get a compulsory supply from Birkenhead than develop your own supply.

Mr. CHARTERIS said it was all a question of price. He gathered that it would not, because the Company were now paying their statutory dividends. The present cost of the water was 3½d. per 1000 gallons, and they were not likely to buy higher than this if they could help it. He submitted a clause giving effect to the view which he had put before the Committee.

Mr. SQUAREY, on behalf of the Wirral Rural District Council, also asked for a clause providing that, in the event of the present water

supply in Wirral being diminished, Birkenhead should be compelled to grant a supply upon reasonable terms.

Mr. CLEASE, for the Cheshire County Council, also brought up an alternative clause, and advanced similar arguments to those used by Mr. Charteris and Mr. Squarey. He admitted that, having incurred the expense of the scheme, Birkenhead should have the "first drink." But, subject to this, the Corporation should be compelled to supply the districts through which the aqueduct passed, at a price not exceeding 10 per cent. on the amount expended up to the point of junction. Thus an authority within 4 miles of the Alwen reservoir would pay less than an authority 20 miles distant.

Mr. FITZGERALD, in reply, insisted that the promoters' clause carried out precisely the decision of the Committee. They were now asked to go behind that decision, and enable the various petitioners to get a supply of water at a lower price than they would otherwise have to pay. Birkenhead was to undertake the expenditure of a million sterling, and then be required to supply these districts at a lower rate than that at which they could get water for themselves.

After a short deliberation, the Committee decided that they could not accept the alternative clauses proposed; and that brought up by the promoters was therefore incorporated in the Bill.

The position of the Dee Conservancy was next considered.

Mr. BALFOUR BROWNE brought up a clause setting forth that if, at any time within seven years after the commencement of the delivery of the compensation water from the Alwen reservoir, the Board of Trade were of opinion that, by reason of the impounding or abstraction of the water, any damage or injury was caused to the navigation, the matter should be referred to an arbitrator to be appointed by the President (for the time being) of the Institution of Civil Engineers; and if the arbitrator found that any damage or injury had been caused to the navigation, the Corporation would pay such compensation as the arbitrator awarded. Power was given to award costs against or in favour of the Corporation.

Mr. CHARTERIS, for the Conservancy, proposed an alternative clause, which, he submitted, gave effect to the view expressed by the Committee. It provided that the Corporation should pay to the Conservators, by way of indemnity against damage and injury that would be done to the navigation by the impounding and abstraction of water, such a sum as should be agreed upon between them, or, failing agreement, should be fixed by any arbitrator appointed by the Board of Trade. The costs of the arbitrators were to be defrayed by the Corporation, who were prohibited from impounding any water until the money had been paid. Counsel said in the case of the Forth the question was submitted to arbitration within six months of finishing the works.

Mr. BALFOUR BROWNE pointed out that in their clause the Conservancy decided the matter in their own favour first of all. Surely it was right that they should ascertain whether any injury was done, especially in view of the fact that there were now to be only two reservoirs instead of three, and that the compensation water was increased from one-fourth to one-third of the quantity impounded. If, after this, any damage was done, the Corporation would pay for it; but surely they must first ascertain the facts.

Mr. CHARTERIS remarked that, after the water was impounded, the mischief was done; and the Conservators wanted to be able to protect themselves when the damage arose.

In reply to the Chairman, Mr. BALFOUR BROWNE said the promoters were quite willing that the arbitrator should be appointed by the Board of Trade, provided he was a practical engineer.

The CHAIRMAN then said the Committee were prepared to accept the promoters' clause, with an amendment substituting the Board of Trade for the President of the Institution of Civil Engineers.

Mr. POLLOCK stated that, in view of this decision, the Conservancy retired from the further consideration of clauses, and reserved their right to renew their opposition elsewhere.

Mr. BALFOUR BROWNE intimated that, notwithstanding the action of the Conservancy, he was prepared to insert a number of clauses which had been framed by them, and agreed to by the promoters, for their protection.

These clauses were then embodied in the Bill, and it was ordered to be reported for third reading.

Shanklin Gas Bill.—The Shanklin Gas Bill came before the Committee of the House of Lords on Unopposed Billis on Monday of last week, and was passed without amendment. Mr. W. A. Valon, the Engineer advising the Company, Mr. E. W. Drew, the Accountant, Mr. Frank C. Taylor, the Engineer and Manager, and Mr. C. H. W. Johnson, of Messrs. Torr and Co., the Agents, were in attendance on behalf of the Company.

Moisture in Coke.—Writing to the "Manchester Guardian," G.E.K. says: "Your columns have lately been occupied with the question of moisture in yarn. In a recent delivery of coke, I lately accurately estimated the amount of water as 30 per cent. (nearly 10 cwt. out of 34 cwt.). Needless to say, it was quite useless as fuel until dried. The law already takes cognizance of excess of water in milk, butter, and tobacco; but can any of your readers inform me what percentage constitutes fraudulent excess in coke, especially as I understand that coke is often passed through water hot from the retorts?"

Gas and Electricity at Stafford.—The annual report of the Stafford Gas and Electricity Committee, which had been adopted by the Town Council, stated that the total revenue of the gas-works was £31,327, and the gross expenditure £16,243; leaving a profit of £15,083, compared with £13,546 last year. There was a net available balance of £4902. The Committee recommended that £2000 should be transferred to the district fund in relief of the rates, £50 be given to the Free Library, £1000 be transferred to the suspense account in reduction of the debt on the water-gas plant, £1278 be added to the reserve fund, and £100 be added to the bad debt reserve fund—the balance, after paying the bonus to the employees, amounting to £450, to be carried forward. As to the electric lighting works, the total revenue was £3971, and the expenditure £1526; the gross profit being £2445. Interest on loans absorbed £863, the sinking fund £1115, and income-tax £61. The Committee asked for a contribution from the rates equal to the amount of the loan repayment.

LEGAL INTELLIGENCE.

SOUTH METROPOLITAN GAS COMPANY AND THEIR ASSESSMENT APPEAL.

Application to Quash the Recent Decision.

In the High Court of Justice, King's Bench Division, Divisional Court, on Friday last, before Mr. Justice Darling and Mr. Justice A. T. Lawrence,

Mr. DANCKWERTS, K.C. (with him Mr. Ryde), said he was instructed to move for a *certiorari* to bring up a decision of the County of London Court of Quarter Sessions to be quashed on the ground of disqualification on the part of one of the Justices who heard the appeal. As their Lordships no doubt knew, the South Metropolitan Gas Company traded on the south of the Thames, and their mains ran through twenty-two parishes, upon which they paid annually in taxes more than £88,000. At the quinquennial valuation the assessment of the South Metropolitan Company as well as of the Gaslight and Coke Company was greatly increased in every parish. In eleven of the parishes the Company were able to agree with the Overseers upon the amount; but in the other eleven cases they were unable to agree, and they appealed against the decision of the Assessment Committee to the Quarter Sessions of the County of London. The appeal was heard before that Court on a number of days, and among the Justices was a Mr. Willoughby, who was an *ex officio* Justice—he being Chairman of the Holborn Assessment Committee. The ground for the motion was that he being under the possibility of bias as such Chairman, ought not to have sat and heard the case. As Chairman of the Assessment Committee, he was a member of a body who were possible litigants in exactly similar cases brought by the Gaslight and Coke Company. The great question in dispute was as to the amount of tenants' capital to be allowed. As Chairman of the Assessment Committee, Mr. Willoughby must have taken part in the assessment of the Gaslight and Coke Company; and he was therefore a person who—together with the other Assessment Committees in the Metropolis—had common interest in the matter, and a possibility of bias. On this ground, he (Mr. Danckwerts) submitted that Mr. Willoughby should not have sat at Quarter Sessions to hear the case. During the course of the hearing Sir George Livesey became aware that Mr. Willoughby was Chairman of the Assessment Committee; but he explained in his affidavit that he was not conscious of the position which was thereby created. Hence there was certainly no waiver of disqualification on his part. Mr. Willoughby did not sit every day; and when a point was taken by Counsel for the Gas Company that only Justices who sat and heard the whole case should adjudicate upon it, Mr. Wallace, the Chairman, expressed his especial desire that this objection should be waived in the case of Mr. Willoughby, who was absent for one day, on the ground that he intended to be largely guided by Mr. Willoughby. In the result, the decision of the Court was unanimous; and, therefore, he (the learned Counsel) concluded that Mr. Willoughby was a weighty factor in the Court as constituted. Counsel for the Gas Company waived Mr. Willoughby's absence for one day, but nothing more than that, in deference to the expressed wish of the Chairman. In the case of *The Queen v. Justices of Great Yarmouth*, where there were appeals to Special Sessions against the poor rate, and one of the appellants was the Mayor who sat on the bench during the hearing of the appeals to which he was not a party, and afterwards conducted his own appeal, the High Court objected to the constitution of the Court and granted a *certiorari* to set aside the decision on the ground that the Mayor was interested in one of the cases, although he had not taken part in the decision of that case.

Mr. Justice DARLING: We think that what you have brought before us raises so very grave a question upon a point as to which there seems to be so little authority, that we shall grant a rule, though we express no sort of opinion upon the case.

ALTERNATIVE SCHEMES FOR LAYING GAS-MAINS.

An Arbitration at Newtownbreda.

Last Saturday week, at the Newtownbreda Petty Sessions, Mr. James M'Lean, R.M., and Mr. J. Blakiston-Houston, D.L., sat as Arbitrators in a dispute which had arisen between the Belfast Corporation and the County Council of Down, in regard to alternative schemes for the laying of pipes for the supply of gas to that portion of the Cregagh district which lies outside the city boundary but within the area to which the Belfast Corporation have a right to supply gas.

Mr. A. J. LEWIS appeared for the Corporation; Mr. B. N. JOHNSTON, for the County Council of Down; and Mr. WILLIAM HARPER, for the Castlereagh Rural District Council, who had also an interest in the schemes. Mr. JAMES QUAIL represented a number of the Cregagh residents.

Mr. LEWIS said the application was a somewhat unusual one. He did not know that one like it had ever been made in that Court, or at any local Petty Sessions before. Certainly the Corporation had never had occasion to do so, because they had never had to encounter the opposition which they had met in regard to the public work which they proposed to carry out in the district. The Corporation of Belfast had a right to supply gas to districts outside the boundary of Belfast; and one of these was what he might describe as the Cregagh Road district. The roads in that neighbourhood were not vested in the Corporation, but in the County Council of Down. Consequently the Corporation of Belfast, in laying a gas-main along them, came into conflict with the County Council. There was a procedure under the Act of Parliament by which any difference had to be submitted to two Justices. In the Cregagh Road district, there had been a great many people who had made due application for a supply of gas; and the

Corporation had been perfectly willing and anxious to let them have it. About the beginning of the present year, the Corporation determined to extend their mains; and about January they proceeded to open up the footway for the purpose. They had not proceeded far when they were called upon to halt by the County Council of Down. After having read a quantity of correspondence on the subject, Mr. Lewis submitted that there were differences between the Corporation and the Down County Council. The plan of the Corporation was to lay the gas-main in the footway from the borough terminus through the Cregagh district. The plan of the County Council was to have it laid in the centre of the road underneath the tram-lines. It was now for their Worships to say which, in their opinion, was the more reasonable plan of the two. He condemned the plan of the County Council as costly, inconvenient, and dangerous. Laying the main under the footway would cost £395, and under the tram-lines £1045. The inconvenience in the County Council plan would be the ripping up of the square setts and the dislocation of the tram service; and then there would be the danger of explosion, and other risks. The Corporation plan, on the other hand, would be cheap, convenient, and safe.

Mr. HARPER said that the Castlereagh Rural Council claimed to have the control and management of the road. They did not want to offer any obstruction to the supply of gas; but under the footway was the only place where the Council could lay their sewer-pipes, and these would have to be laid or else the houses would be closed up. He suggested that the gas-pipes should be laid on the left side of the road, but not on the footpath.

Mr. *Alexander M'I. Cleland*, the Chief Inspector of the Belfast Gas Department, said it would be a physical impossibility to lay the pipes as Mr. Harper suggested, because there would be difficulties in connection with the trolley-poles and square setts.

Mr. LEWIS, after some argument, suggested the possibility of the sewer-pipes being laid 6 feet under the footway, and then the gas-pipes could be laid above them, at a depth of 1 ft. 6 in. from the surface. He thought an adjournment would be advisable to see if there would be any engineering or other objection to this suggestion.

The Magistrates thereupon adjourned the case for a month.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Wednesday, May 29.

(*Before Mr. Justice* SWINFEN EADY)

Wombwell Urban District Council v. Dearne Valley Water Company.

The hearing of this case (*ante*, p. 595) was resumed this morning.

Mr. EVE, K.C., Mr. MACMORRAN, K.C., and Mr. MACKENZIE appeared for the plaintiffs; Mr. ASTBURY, K.C., Mr. ALEXANDER GLEN, K.C., and Mr. JOHNSTON represented the defendants.

Mr. *J. M. Wilson*, M.D., the Medical Officer of Health to the East Riding County Council, was the first witness. He said the district under his charge was immediately adjoining Wombwell. In his opinion, in such a district an adequate supply would be not less than from 23 to 25 gallons per head per day in the summer; and in winter from 18 to 20 gallons. This included an allowance for baths and closets, which would be from 7 to 8 gallons per head. He had visited Wombwell, and in his opinion the sewerage was satisfactory there, though he agreed with Dr. Millar's evidence that an extension of the water-carriage system was desirable. He considered the demand of 15 gallons per day very moderate.

Cross-examined: The nearest point to Wombwell which had been under his control was Bolton-on-Dearne; but he could not say what the supply per head was, as in his time, which was five years ago, the greater part of the water was drawn from wells. Witness was cross-examined with regard to a discussion which took place in August last on a paper he read on the water supply of rural districts. He stated in the paper that "in towns from 15 to 20 gallons was a fair average, and in rural districts 5 gallons;" but he did not refer to a town like Wombwell. In Goole the supply was 23 gallons per head, and none of it was used for flushing sewers or roads.

Re-examined: In 1893, he made a report on the water supply of Bolton-on-Dearne, in which he pointed out the urgent necessity for providing a better service.

Mr. *Edward Brooke*, the Surveyor and Water-Works Manager at Ardsley, said he was engaged by the plaintiffs to take the readings of the water-meters at Four Lane Ends on the 18th of May and the following days. He produced the records, which covered twelve hours on each day; someone else being responsible for the other twelve. A table was put in showing the quantity passing each day for a week. It varied from 172,450 to 194,860 gallons. During the whole of the time he was on duty, the valves belonging to the plaintiffs were fully open, except on one occasion, when the pump was stopped for 20 minutes on the 20th of May. He fixed a recording pressure-gauge on the service-pipe at Warren House pump, which was supplied direct from the Water Company's 10-inch rising main; and the record showed the pressure for 24 hours, except for half-an-hour a day, when the gauge was removed to allow the day's supply of water to be taken. He took a record on each day up to the 26th. The pressure varied from about 73 lbs. to 120 lbs.

Cross-examined: A foot-head of water was equal to 0·434 lb. A pressure of 200 lbs. at the pumps would equal a head of 460 feet; and the pumps being 132 feet above Ordnance datum, it gave a height of 592 feet—the height of the Hoyland reservoir. Taking the height at Four Lane Ends to be 418 feet, 124 lbs. pressure would be sufficient to reach it; and if there were 200 lbs. at the pumps, there would be a surplus of 76 lbs. The height of Warren House, where the pressure-gauge was placed, was 395 feet. The lowest pressure shown on his records was about 65 lbs., which was equal to 151 feet, or 128 feet above the level of the valves at the station. The pipe on which the gauge was fixed served two cottages and a shed; but he took precautions to prevent any taps being opened which would affect the pressure.

Mr. *James Crawford*, the Chief Inspector of Water-Meters to the Leeds Corporation, gave similar evidence as to the taking of the meter reading not covered by the previous witness. He said the valves were open to the full the whole time, except on one occasion when the engine was stopped for 2 hrs. 49 mins.

Mr. *J. H. Taylor*, the Borough Surveyor Water-Works Manager at Barnsley, said he visited Wombwell on the 8th of November last, in company with Mr. Silcock and others, and examined the rate at which the water was passing the valves—viz., 6000 gallons per hour. He noticed that the pump was occasionally drawing air, owing to a deficiency of water entering the tank. The Jump and Roebuck Hill reservoirs were empty, and the water was being pumped direct into the mains. He visited the district, and found there was a deficiency of water. On the 10th of November, he found the supply to the pump was insufficient. In December he went to Wombwell, and found scores of houses without any water, even in the middle and lower levels. He examined the meters, and ascertained that the water was passing at the rate of only 101,000 gallons per day. On the 24th of January, he went again, with the defendants' Engineer and Solicitor. On examining the meters, he found that the daily rate was 151,000 gallons. The engine and pump were going well; but the pump at times drew air instead of water. On that occasion there was 3 ft. 6 in. to 3 ft. 9 in. of water in the reservoirs. There was some natural supply—about 8000 gallons a day—running into the Jump reservoir. On the same day he found 7 ft. 9 in. of water in the Hemingfield reservoir. On the 6th of April, he again went by appointment, and examined the works. He found the valves as stated in Mr. Silcock's evidence. He produced a sample of a reducing-valve such as was employed by defendants, and explained its action. When he saw it, the lever was wedged, so that it would not act; and he found it in the same condition a few days ago. In April, they opened the valves slightly; and the quantity of water passing was immediately increased. It went up to 11,820 gallons per hour; and the pump was quite capable of dealing with it, by increasing the speed of the engine. On opening the valves still further, the water went in so fast that the tank overflowed. The engine and pump were quite equal to dealing with 210,000 gallons per day. From his experience, he should say that 15 gallons per head was an absolute necessity in such a district in summer and dry weather. He knew the quantity supplied in similar districts, and had drawn a map showing it in various places in the immediate neighbourhood. In adjacent districts, he had prepared schemes for water supply in which he had calculated 20 gallons per head on double the present population. There was considerable variation in the quantity of water passing the meters, which he should account for by fluctuation in the pressure in the main. There was no other way of accounting for it, if the valves were not interfered with. If the reducing-valve had acted properly, the pressure would have been kept regular. Variations of pressure in the main could only arise from two causes—alterations in the pumping operations at Broomhill, and variations in the draft on the main by other consumers situated at a lower level. Any deficiency in pressure in the main could have been compensated for by opening the valves, as was shown by the experiments. He thought it very probable that the dirt-boxes not being properly cleaned out from time to time had retarded the flow of water; and very possibly an improvement in that respect had been the cause of the increased supply since April. Witness then described an experiment he had made at Barnsley by fitting up pipes and meters similar to those at Wombwell, and he found that with a pressure of 124 lbs. the water would pass through such an arrangement at the rate of 254,880 gallons; but when the pressure was reduced to 80 lbs., the quantity passing was at the rate of 192,384 gallons. He took the greatest care to have the valves exactly as they were at Wombwell. He then opened the inlet-valves a quarter-turn more, keeping the pressure at 80 lbs.; and the quantity passed was at the rate of 264,960 gallons. The records produced from the pressure-gauge at Warren House tended to confirm his experiments at Barnsley.

Cross-examined: Houses might be short of water owing to defects in the distributing mains and pipes. There was considerable divergence of opinion as to the quantity required per head of the population; it depended partly on the habits of the people. After a long cross-examination as to the water supply of adjacent districts, witness put in the map he had prepared, showing the population and consumption per head of many places in the neighbourhood of Barnsley which were supplied in bulk from that town. He said they were not limited in any way, but took as much water as they wanted.

Re-examined: Whether or not the conditions of his experiments at Barnsley were exactly the same as those at Jump, the results showed that a difference in pressure affected the quantity of water passing the meter.

Mr. *Frank Massey*, the Manager of the Wakefield Water-Works, as well as of neighbouring water-works at Sandal, which was a place similar in character to Wombwell, gave evidence in regard to several visits he had made to the latter place. He referred particularly to the Hemingfield reservoir and the quantity of water flowing naturally into it; and he also spoke to visiting a number of houses at Wombwell, and finding no water on. He confirmed the evidence of previous witnesses as to the quantity passing the meters, the state of the valves, and the capacity of the pump and engine to deal with all the water coming into the tank; also as to the reducing-valve being so fixed that it could not operate. He attributed the fluctuation in the water supply chiefly to the variation in pressure owing to the draft on the main; probably also, on account of the small extent to which the valves were opened, they would partially silt up, and check the flow. The extra flow which occurred when the valves were temporarily opened further would remove the deposit; and this might account for the better supply which had been noticed since.

Thursday, May 30.

Mr. *Massey* was re-called this morning for further examination. He said he thought the demand for 210,000 gallons of water per day in August and September last was very reasonable. In 1905, at Sandal, the maximum average consumption was upwards of 15 gallons per head; but in 1906 it was less, because the season was wetter. Witness put in a diagram showing the mean average throughout the year and also the maximum and minimum. He said the district was very similar in character to Wombwell.

Cross-examined: Sandal immediately adjourned Wakefield; but he should not call it a residential suburb. There were no collieries; but there were several in the immediate neighbourhood, and the workmen lived in Sandal. In 1906, the average consumption was 11·3 gallons per head; June and July being the heaviest months. He could not offer any explanation of the extraordinary fluctuation (between 65 lbs. and 100 lbs.) in the pressure-gauge at the Warren House on one particular day. Witness was further cross-examined on some details of the pressure-gauge records, and said he could not believe the defendants' pumps were working constantly when there was a drop of from 100 lbs. to 70 lbs. for several hours continuously. The lower pressure was just what would be given by the back-pressure from the Hoyland reservoir, without pumping. He thought there must be some mistake in the pumping records. There was no other explanation, unless the pressure-gauge was all wrong.

This concluded the plaintiffs' case.

Mr. MACMORRAN, in summing up the case, said the issues were whether the defendants had furnished the supply of water reasonably required, as the agreement contemplated, and whether the pressure had been kept up. With reference to the quantity reasonably required, he submitted that municipal purposes must be included; and it was evident that the supply had not been sufficient to meet this requirement. Up to August, 1906, the defendants had been delivering water under sufficient pressure to carry it over Roebuck Hill, which gave enough head to distribute it over the district; but on the date mentioned the reducing-valve was put in, with the view of cutting off the pressure, and delivering the water at Four Lane Ends at such a head that it would not go over the hill. Assuming that the defendants had a right to do this, it became the duty of the plaintiffs to provide means for forcing the water delivered at Four Lane Ends over the hill. This they did, and constructed a tank on Roebuck Hill to keep the supply regular. Nevertheless, complaints of want of water still continued; and as it was proved that the pump was capable of sending more water than was delivered, the conclusion was obvious that defendants had not furnished the quantity required. The defendants suggested that the plaintiffs had purposely prevented the inflow of the water. This was a very serious issue; and there could be no possible object in acting so absurdly and improperly. It was not for the plaintiffs to explain how it was that the supply was deficient. The fact was obvious; and it was for the defendants to explain it. It was very curious that since the 6th of April the supply had been sufficient. The real question was what the plaintiffs were entitled to ask for; but, in any case, the quantity supplied was insufficient for the wants of the district at the time the action was brought, and down to April last. Counsel went on to submit that the plaintiffs were entitled to have the water delivered under pressure according to the agreement of Dec. 12, 1905; and he pointed out that if this had been done, no difficulty would have arisen. If the plaintiffs were right on this point, the question of damages came in, because they had been put to the expense of erecting the pumping apparatus. He concluded by offering a few remarks on some points raised in the defence, and said there was nothing in the agreement to exclude the use of water for trade purposes.

(To be continued.)

Charge Against a Gas Manager.

At the Church Stretton Petty Sessions, Edward Short was charged recently with embezzling money belonging to the Church Stretton Gas Company, of which he was at the time Manager and Secretary. Mr. S. Meeson Morris, who prosecuted on behalf of the Company, pointed out that, instead of giving all receipts for money in the way prescribed by the Company on their official forms, defendant gave receipts to various people on the face of their bills. Considerable sums which he received from these people were not entered in the books; and the moneys were appropriated by defendant to his own use. The books were in a mess; and the Company, who had no wish to be vindictive, felt it their duty to bring the case forward. Mr. E. S. Stones, the Auditor to the Company, said the total deficiency was over £87. Defendant pleaded guilty. Mr. Bowdler, on his behalf, asked for leniency, and said his client had been placed in a position for which he was unfitted. He pleaded for mercy for the sake of his wife and children, and put in some excellent testimonials. A sentence of three months' imprisonment was passed.

Increase in Price at Salford.—After a long discussion, the Salford Town Council decided to increase the price of gas as from the 1st prox. by 3d. per 1000 cubic feet to ordinary consumers, and to reduce the quantity supplied for 1d. to prepayment meter users from 30 to 28 cubic feet. The first-named proposal was carried by a large majority; but in the case of the latter, the voting was 19 for and 16 against. The Chairman of the Gas Committee, Alderman Phillips, explained that the increases were necessitated by the price of coal.

Proposed Purchase of the Crewkerne Water-Works.—The question of the purchase of the water-works, which has been under consideration for some months, was again referred to at a meeting of the Crewkerne Urban District Council last Tuesday. In reply to an offer by the Council to buy the undertaking, the Secretary to the Company wrote that the Directors would submit the matter to the consideration of the shareholders, if the Council would make them an offer of £16,535, which would include the amount to be paid as compensation to the officials; the Council in addition to pay the costs incurred by the Company in the negotiations, as well as in the transfer of the undertaking and the winding up of the Company. The Council passed a resolution to the effect that, while declining to acknowledge the right of the Company's officials to any compensation, it would be just to advance the Council's offer by £500 to cover the legal and other expenses of transfer and of winding up the Company, so that the holders of shares might receive clear the £3 10s. per share. It was, therefore, decided to make this additional offer, with a request that it be accepted or declined at an early date.

MISCELLANEOUS NEWS.

NOTTINGHAM GAS INQUIRY.

Committee's Report Adopted.

It had been anticipated that the presentation yesterday morning, at the meeting of the Nottingham City Council, of the report of the Special Committee dealing with the management of the Corporation gas undertaking might lead to some discussion; but the unexpected happened. The Mayor formally moved the reception of the report without making any observation; and this being seconded by Mr. Elborne, the resolution was carried without debate. This seems to convey the idea that the Council have heard enough of the matter.

GAS SUPPLY OF FAZAKERLEY.

Discussion in the Liverpool City Council.

At the Monthly Meeting of the Liverpool City Council last Wednesday, a discussion took place with regard to the proposal to erect gas-works at Fazakerley, under the recently-secured powers of the Corporation.

Alderman SMITH moved the adoption of the recommendation of the Tramways and Electric Power and Lighting Committee, that an application be made to the Local Government Board for sanction to borrow the sum of £25,000 for the erection of gas-works at Fazakerley, and the laying of the necessary mains, service-pipes, &c., under the powers of the Liverpool Corporation (Fazakerley) Gas Order, 1906. He said he hoped the Council would see their way to follow in this case the line which they did when they obtained the electric lighting and power undertaking, and that they would establish their own gas-works, with the object of providing gas for the portion of the city in which they were entitled to provide it at the very cheapest possible rate. The Council might very well be asked by the Lighting Committee to give them this facility, bearing in mind the care and attention that had been given by the Committee to the work entrusted to it, and the great saving that would be effected.

Mr. PARIS, who seconded the proposal, said he did so because the provision of a gas-works at Fazakerley would be a good thing for Liverpool. If they could compel the Liverpool Gas Company to reduce the price which they were already charging by 1d. per 1000 cubic feet, it would mean a saving to the ratepayers of £15,000 a year; and if they could compel the Company to reduce the price by 6d., it would mean a saving to the ratepayers of something like £90,000 a year. They had reason to believe that, with the large number of buildings now being erected in the Fazakerley district, there would be a great demand for gas; and this being so, he thought the Committee would be able to supply gas at something like 1s. 8d. to the consumers. They felt that the Company had too long had a monopoly.

Mr. STODDART thought Alderman Smith would have had something to say with regard to the action of the Company in making a very favourable offer to them. He did not see why they should spend £25,000 on the erection of gas-works at Fazakerley, when the total consumption there would be a very small amount. The Company had offered to supply them at something like 1s. 9d. per 1000 cubic feet; whereas it was going to cost the Committee to manufacture gas at Fazakerley about 2s. 4d. If it was intended to lay out Fazakerley as a garden city, he did not think the erection of a gas-works there would improve the scheme. He opposed the proposal.

Mr. HIGGINBOTTOM, in supporting the recommendation, said that the people of Fazakerley were anticipating more efficient lighting in the district. This was one of the matters referred to at the conference when the question of the inclusion of Fazakerley in Liverpool was considered. It was a growing suburb. From the pecuniary point of view, he thought about 12 million cubic feet might be put down as the rate of consumption for Fazakerley alone; but by the time the gas-works were established (in two or three years), they could easily promise 15 millions. He pointed out that the Liverpool Gas Company would take no notice of them at first, and would not apply for powers for Fazakerley; but now that Fazakerley were getting in the thin end of the wedge, and were making a counter proposal, the Company gave them a figure to get hold of them for a period of ten years. He maintained they ought to have these powers in their own hands.

Alderman MAXWELL said he had always understood that the electric lighting undertaking was started with the idea of checkmating the Gas Company, or, at any rate, with the object of forcing down the price of gas. That had not been the effect, however, and the Company were still flourishing. If the Company were forced to reduce charges, it was bound to have a detrimental effect on the Electric Lighting Department; and many people who now used electric light would revert to gas as an illuminant—especially in view of the improvement in the incandescent system.

Mr. ALSOP said it seemed to him that if the Company were willing to do as they offered, there were two obvious advantages in accepting the offer. First, because they would be getting gas for Fazakerley cheaper than the estimates of their Engineer stated they would be able to supply it themselves. Secondly, supposing they took gas in bulk, they would only be paying for the exact number of cubic feet which they used; whereas under the scheme of the Council they would have to provide for 30 million cubic feet, and the present consumption was estimated at about 12 millions. Therefore for a long time to come their capital would be lying idle.

Alderman WATTS asked whether the fact that the Company were prepared to supply them at 1s. 9d. per 1000 cubic feet did not prove clearly that they had been charged a great deal too much. He thought the Company undoubtedly had a huge monopoly. They had done the best for themselves, not for the citizens. He supported the proposal

that they should now take the matter into their own hands. It was monstrous that they should have to pay 2s. 4d. per 1000 cubic feet.

Mr. ELLIS said, assuming it was found they had to charge more than the Company were charging them at present, would the people of Fazakerley bear the burden themselves or would they want other districts to bear a proportion of it?

Alderman OULTON said he held no brief for the Company, nor had he any interest in the concern; but, as a gas consumer, he was well satisfied with the way in which they had done their business.

Mr. CHEVALIER asked whether, on establishing the gas-works at Fazakerley, they would eventually be able to use that gas for power purposes as well as lighting; and also whether this would extend to Liverpool, or whether the Company could prevent them from ever entering Liverpool with gas under any conditions.

Mr. WALKER, replying to Mr. Chevalier, said it would enable them to supply power to Fazakerley. They could not enter Liverpool; but the Committee were of opinion that if the Council passed the proposal that day, they would in time be in a position to make gas at a considerable profit to the citizens of Liverpool. They had a great scheme before them; and they could give power considerably cheaper than they were having it to-day. Moreover, it would tend to bring manufacturers into the district.

It having been announced that shareholders in the Gas Company could not vote, a division took place; and the recommendation was adopted by 78 votes to 12.

It was agreed that, pending the completion of the gas-works at Fazakerley, arrangements should be made with the Gas Company for a supply of gas in bulk for distribution by the Corporation to consumers in Fazakerley; and that the necessary work of laying mains, &c., and providing meters, should be carried out, at an estimated cost of £3000.

GAS-WORKS RESULTS AT BELFAST.

When moving the adoption of the Gas Committee's minutes, the Chairman (Mr. J. A. Doran) informed the members of the Belfast City Council that the gross profit on the manufacture and sale of gas and residuals during the past financial year was £61,867; and deducting the interest on capital, &c., £10,716, they had a net profit of £51,152, as against last year's amount of £56,173, or a decrease of £5022. The falling off was, however, more than accounted for by the increase in discounts and decrease in price of gas to prepayment consumers. The balance brought forward from last year's account was £61,338. Out of this, the following amounts were allocated by resolution of the Gas Committee on Jan. 4, 1907: Depreciation on the general expenditure, £22,187; depreciation on prepayment meter system, £2988; and reserve fund, £30,000. This made a total of £55,176, and left a balance of £6162. If they added to this the net profit of the current year, £51,152, the profit on stoves repairs account, £563, and the interest from the bank, £340, they had a total of £58,217. Out of this amount, the following sums had been set aside: Sinking fund, £5802, equivalent of interest on redeemed stock, £2468; and interest on insurance suspense account, £1226. These deductions, amounting to £9496, left a balance of £49,721. The Committee had also made the following payments for the public good to the Finance Committee: In aid of rates, £15,000; and dividends and sinking fund on new City Hall stock, £10,271. This was a total of £25,271, and left a balance at credit of profit and loss account of £23,450.

SATISFACTORY WORKING AT SOUTHPORT.

The annual report of Mr. John Bond, the Gas Engineer to the Southport Corporation, dealing with the year to March 31 records a continued increase in the sale of gas—the make of 505¾ million cubic feet being 4·22 per cent. more than that of the previous year. The increase in the sale of gas was 3·63 per cent. The gas sold by means of prepayment meters was 8·72 per cent. of the whole, as compared with 7·85 per cent. in the preceding twelve months. The Southport Corporation pay to the Birkdale Council 8d. per 1000 cubic feet on the gas supplied in the township of Birkdale, which, for the twelve months, amounted to £2663. During the year, says Mr. Bond, the greater portion of the retort-house and carbonizing plant have been reconstructed. The retort-house has been raised 13 feet, and the open furnaces with segmental retorts have been replaced by eleven regenerative retort settings, making in all fifteen settings of eight through retorts, all working on the regenerative principle. These retorts are capable of producing 1,700,000 cubic feet of gas per day. The new system is giving excellent carbonizing results; and for a considerable time it has been working without the aid of carburetted water gas as an enricher. The price of coal has advanced considerably; but they are able to minimize the effect this would otherwise have had on the cost of gas by obtaining better results in the manufacture of coal gas, due, chiefly, to the improvements made in the carbonizing plant. The West's compressed air stoking machines, after working continually for six years, have been cleaned and thoroughly overhauled. These machines have been lifted on to the stage flooring in front of the retorts, and work much easier under the new conditions. The erection of a new engine-house is being proceeded with on the site of the old retort-house; and the air compressor which works the stoking machines has already been erected on a substantial foundation in this house. Gas-mains, in connection with the washers and scrubbers, have been re-arranged; so that they are now able to work them in series or in parallel. The "Metropolitan" argand No. 2 burner (the use of which, as already recorded in the "JOURNAL," has been sanctioned by the Board of Trade) has been fitted to the Corporation photometers in place of the "London" argand No. 1 burner.

Turning to the financial side of the undertaking, Mr. Bond remarks that this continues satisfactory; there being a decrease in the capital expended of 2d. per 1000 cubic feet of gas sold, and of 7d. in the capital outstanding. The profit on the twelve months' working is slightly higher than the estimate; the gross being £27,088, and the net £13,000, which amount has been paid to the borough fund in aid of the rates. The number of gas-cookers in use at the end of the year was 6287, as against 5441 in 1906. The number of new cookers fixed was 862 on hire and 62 on hire-purchase. During the year 495 service-pipes were laid, and 555 new meters fixed; the total number of meters in use at the end of the year being 17,303, or an increase on the previous year of 461. The number of public lamps in the district of supply at the end of the year was: Ainsdale, 66; Birkdale, 478; Southport, 1846—total, 2390.

BIRKDALE AND THE SOUTHPORT BURNER.

Some reference was made at the last meeting of the Birkdale Urban District Council to the recent decision of the Board of Trade (*ante*, p. 471) to allow the Southport Corporation to use the "Metropolitan" No. 2 burner for testing purposes, in place of the "London" argand No. 1 burner. Attention was called to the matter by Mr. Pye, who pointed out that on the 16th ult. Mr. Keeley made a test of the gas supplied to Birkdale. He found it had gone down from 16 to 13·33 candle power, or rather over 2½ candles less than the standard, which was a reduction equal to 2d. per 1000 cubic feet in the illuminating power, and 3½d. in its calorific value. According to the agreement entered into with the Southport Corporation in 1902, when the illuminating power of the gas supplied at Birkdale was reduced from 30 to 16 candle power, a clause was inserted prohibiting any further reduction, except by a joint agreement entered into by the two Councils interested. By adopting this new burner, they reduced the value by a subterfuge; and so got behind the agreement, and supplied the district with an inferior quality of gas. He had been told that the Corporation, owing to the advance in the price of coal, if they had not been successful in obtaining the reduction in the value of the gas supplied to their district, would certainly have advanced the price. This, he considered, was all nonsense, having regard to Sheffield and other towns, which, in spite of the advance in the price of coal, had only recently reduced their gas charges. Manchester had adopted the same burner as Southport had recently been empowered to adopt for testing purposes; but what did the Corporation do? They immediately, on adopting the new burner, advanced their standard of illumination from 16 to 18 candles; and this compensated their consumers, who got practically the same gas as before. Why was not Southport serving them in the same manner? They had adopted the same burner; but they made use of it for their own advantage in reducing the quality supplied to the district, which meant an enhanced profit to reduce Southport's rates, and was of no benefit at all to Birkdale. He would strongly advise the Birkdale Council, in the best interests of the place, if they could not get fairly treated by the Corporation of Southport in regard to their gas, to take steps to provide a supply for themselves, and so throw off the yoke of Southport.

SUCCESSFUL YEAR AT ST. HELENS.

It was stated by Mr. James Crooks, J.P., the Chairman, in moving the adoption of the Gas Committee's minutes by the St. Helens Town Council, that the past twelve months constituted another successful year's working of the Gas Department.

During the year, he said, 16 additional street-lamps were erected; and the town was now lighted by 1936 lamps, of which 636 were on the incandescent system. The cost of lighting 66 miles of streets had been £5309, against £5236 for 63·8 miles the previous year. The quantity of gas made was 427,612,200 cubic feet—an increase of 22,213,400 feet, or 5·4 per cent., on the preceding year. The total amount of coal, &c., used was 40,440 tons; and the illuminating power of the gas supplied was over 18 candles. The number of consumers' meters had been increased by 1031. The net income from gas sold was £42,496; while £17,912 was collected from prepayment meters, which weighed 38·3 tons, and represented 4,298,928 coins. The total of wages paid during the year was £14,796. The net profit, after payment of interest, sinking fund, and depreciation, was £8218, of which the Committee had voted £5000 to the borough fund. They would be glad if they could only hold out hope of being able to repeat this next year; but owing to the extraordinary rise in the price of coal and all other raw materials, they were afraid they would be unable to do so. A reduction of 1d. per 1000 cubic feet in the price of gas had lowered the income by £316; and they had obtained less than usual for bye-products. The total amount of money devoted to the borough fund account out of gas-works profits was £76,030; and £41,658 was written off capital account.

Mr. Hamblett asked the prices of the new coal contracts, compared with those for the two preceding years. Mr. Crooks, however, said it was not advisable to give the information. Mr. Hamblett suggested that the Gas Committee should consider whether, in view of the extraordinary increase in the price of coal, it would not be advisable for them to co-operate with some other municipality for the purchase of a colliery of their own to provide coals for the gas-works, &c. The proposal was received with laughter; and the minutes were then passed.

Bradford Water Supply.—The balance-sheet of the Bradford Water-Works, prepared by the City Treasurer (Mr. G. A. Thorpe), shows a profit for the financial year ended March 31 of £3016, as compared with a loss during the previous year of £9117. This change is the result of the relief afforded by the recent scheme for the equation of repayment of the water-works debt. The new arrangement was in operation for only a few months last year; and, other things being equal, the current year may be expected to show a still larger profit. The total income derived last year from the water undertaking was £182,751, and the expenditure amounted to £179,735. The gross profit was £143,918, out of which was paid £140,902 in respect of interest and sinking fund; leaving as net profit the sum of £3016.

ANNUAL REPORT ON THE WIGAN GAS-WORKS.

From particulars quoted from the annual report of the Engineer and Manager of the Wigan Gas-Works (Mr. J. Timmins) by Alderman Holmes, the Chairman of the Gas Committee, at the meeting of the County Borough Council, it appears that No. 1 holder was re-sheeted during the past year, and another lift added to it, thus increasing its capacity by 140,000 cubic feet. The storage will now be adequate for some years to come. The coal and cannel carbonized (39,436 tons) shows an increase of 943 tons over the preceding year; while the increase in the make of gas was 12,513,000 cubic feet. The average profits during the last twenty years have equalled £23,117 gross and £8270 net, *plus* the value of gas supplied free for public lighting. The net profit for the past year is represented by £5299 for gas supplied free for the public lamps, and £4414 the balance carried forward to next year's accounts—making a total profit of £9713. The total sum borrowed for gas-works purposes is £373,612, and the amount repaid £84,274. Deducting the sinking funds in hand for repayment of loans, there is left a net debt of £261,872. In 1904, the return from residuals was 10s. 10d. per ton of coal and cannel carbonized; but last year the return was only 8s. 4½d., and the previous year 8s. 1¼d. Within the past twelve months only ten prepayment meter cash-boxes were broken open, and the money abstracted; and these cases have happened where consumers have left houses without giving notice at the gas office, in accordance with the agreement. On the other hand, the boxes are made extensive use of for the purpose of accumulating sums of money between the calls of the inspectors.

CHARGES TO ROTHERHAM PREPAYMENT CONSUMERS.

Recommendations of the Gas Committee relating to a reduction in the price of gas led to a lengthy discussion at last Wednesday's meeting of the Rotherham Borough Council.

One of the clauses was to the effect that the charge to prepayment consumers should remain at 3s. 4d. per 1000 cubic feet for a consumption of under 10,000 cubic feet per annum, but that there should be a reduction to those using more than this quantity—the charge for 10,000 to 12,000 cubic feet to be 3s. 2d. Mr. Grundy moved an amendment that the price should be reduced to 3s. 2d. for those consuming less than 10,000 cubic feet—pointing out that under the Committee's proposal 7300 out of the 9000 prepayment consumers would not receive any benefit at all. These people were the poorest of the poor; and the suggestions of the Committee were for the benefit of the wealthy customers and the manufacturers. Alderman Gummer, in reply, drew attention to the fact that in 1902 the price was increased 3d. per 1000 cubic feet to the larger consumers, while no change was made in the charge to the smaller ones. It did not necessarily follow that because a man was using a prepayment meter he was a poor person. He had a list showing that a number of the automatic consumers lived in very pretentious houses, and that the remarks that applied to the poor would apply to the rich. There were 215 automatic meter consumers who consumed only 1000 cubic feet per annum each, at a cost of 3s. 4d. to the consumer, but of 5s. to the Corporation. The Corporation gave them the whole of the gas, and lost 1s. 8d. by the transaction; and then the Gas Department were accused of not being kind to the poor. He quoted further statistics in regard to the consumers of gas by automatic meters up to 5000 cubic feet per year, showing that, owing to the extra capital outlay, the rate was only 2s. 4d. per 1000 cubic feet, as compared with 2s. 9d. paid by users of ordinary meters, who also were charged meter-rent. It was the large consumers who made the profits of the gas-works.

Only five members voted for the amendment; and the Committee's recommendations were approved.

THE PAST YEAR AT NEWBURY.

The minutes of the Gas Committee, submitted at the May meeting of the Newbury Town Council, stated that the report, balance-sheet, and working statement of the undertaking for the year ending March 31 (which had been audited by Messrs. Wood, Drew, and Co.), had been laid before the Committee, who deemed them very satisfactory. The revenue account showed that the total expenditure for the year had been £8587, and the receipts £11,561; leaving a balance of profit of £2973. From this sum the Committee had to meet sinking fund payments, interest on mortgages, and other charges of £2088; leaving an actual surplus on the year's working of £884. There being no balance of capital in hand, the Committee had defrayed the cost of extensions of mains, purchase of stoves, meters, fittings, new retorts, and other works out of this surplus (costing £843); so that the real balance in hand only amounted to about £41. The reduction in the price of gas effected last year, from 3s. 3d. to 3s. 2d. per 1000 cubic feet, entailed a charge of over £200 against the undertaking. The expenditure for repairs and maintenance during the year had been £1100. There was a paper balance to carry to the next account of £3136. During the twelve months, 5524 tons of coal had been carbonized; and the gas made was 60,657,000 cubic feet.

Alderman Smith, in proposing the adoption of the Committee's report, said he thought it would be conceded that the gas-works were on the upward grade. The output of gas had increased from 58½ million cubic feet to upwards of 60½ millions; while the quantity unaccounted for, thanks to good management and the goodwill of consumers in advising the Manager (Mr. W. R. Davey) of leakages, showed a decided diminution. While the quantity of coal used last year had been 217 tons less than in 1906, the output of gas per ton had been higher. The gross profit had been greater by £184 than in 1906; and while this was not particularly large, yet it was good—especially when they took into consideration the various deductions that had to be made, and the reduction in the price of gas. Speaking fairly, it could not be expected that the works would go on increasing at the rapid rate experienced in recent years; the greater portion of their sources of profit having already been tapped. The price of gas was as low as in any other town of similar size; and while they were doing well, they reasonably hoped to do better. As regarded disposing of the profits, the Committee had fully discussed the matter; and with the prospect of coal, &c., being dearer, and the need for relaying certain mains at an early date, coupled with the present low price of gas, they did not feel justified in making any recommendation on this point. Since 1901 the price of gas had been reduced from 3s. 10d. per 1000 cubic feet to 2s. 10d., which the Committee thought was a sign of great prosperity. The Committee felt that in all probability they would be in a better position next year to deal with the question of apportioning the profits for relieving the rates.

Several members congratulated the Committee on the balance-sheet; it being pointed out that the profits which would have been available for relieving the rates had nearly all been expended in extensions and additions. Alderman Long, however, said that he was not satisfied with the condition of affairs. This was a trading concern ackowledged to be worth £60,000; and yet with a capital of £37,000, the only available surplus was £41. If the undertaking was sold for £60,000, the Council would be able to pay all they owed, and by investing the balance, even in Consols, have a sum of £700 or £800 to assist the rates, while the Committee would have none of the trouble. In reply, Alderman Smith said that when the Council first took over the works the price of gas was 5s. 6d. per 1000 cubic feet, while now it was 2s. 10d., which, to his mind, was a convincing proof of continued prosperity.

The report was unanimously adopted.

STREET LIGHTING IN FULHAM.

Flat-Flame Burners Superseded.

At the Meeting of the Fulham Borough Council last Wednesday, the Lighting Committee reported having gone carefully into the question of the lighting of streets at present illuminated by flat-flame gas-burners—1150 one-burner, 8 two-burner, and 3 three-burner lamps.

It was stated that the Borough Electrical Engineer had submitted several reports on the subject, together with a proposal made by the Gaslight and Coke Company to convert these lamps to the incandescent system, provide the necessary capital, and spread the repayment over a period of five years, and also to light, extinguish, clean, repair, and maintain the lamps. Before agreeing to alter the whole of the flat-flame lamps to the incandescent system, the Committee had carefully gone into a recommendation from the Electrical Engineer advising that the gas-lamps on the line of existing cables should be changed to Nernst electric lighting. There are 134 one-burner lamps and 1 three-burner lamp which could be thus converted. The annual cost of the Nernst lamps is £3 7s. 3d., as compared with £3 4s. 7d. for incandescent gas-lamps. Samples and tenders had been obtained from several makers of up-to-date lanterns in copper and copper and tin—all specially designed for incandescent gas lighting; and the Committee had also obtained from several makers estimates for converting the Council's existing lanterns, in order to make them suitable for incandescent gas lighting. The 16-inch copper and tin lanterns, as made by Mr. William Edgar, of Hammersmith, appeared to be the best of those submitted. They had accordingly erected one in Darlan Road, together with one of the Council's converted lanterns. From personal observations, the Committee found that the 16-inch Edgar lantern gives a far better light than a converted lantern; and having regard to the cost of the alteration and the unsuitable condition of a large proportion of the existing lanterns, they decided to recommend the adoption of the 16-inch Edgar lantern, the price of which, erected complete, is £1 8s. 10d., including the removal of the old lantern. During the Committee's consideration of the matter, the Gas Company offered to make photometric tests of the various types of lamps; and as this would naturally prove of valuable assistance to the Committee, they arranged for tests to be made. From the result, the Committee found that, while the incandescent gas-mantle gave (if anything) more light immediately round the post, it had not the same distributive or penetrative power as the electric Nernst lamp, which showed up to great advantage. The details of the tests are as follows:—

Distance.		Angle.	Reading.	Illuminating Power.
Ft.	In.	Flat-Flame Burners.		Candles.
11	7	30	14·9 lamp fixed about five years.	116
18	3	20	24·10	93
		Electric Arc.		
35	5	30	14·35	1170
		Nernst Lamps.		
19	10½	20	23·95	112
10	7	35	17 05	83
20	3	20	18·20	200
11	4	35	16·10	106
		Incandescent Gas-Lamps.		
16	3	20	21·80	90
9	8	35	15·75	81
15	3	20	24·60	62
9	2	35	18·90	50·5

As a result of these tests, and of their consideration of the question, the Committee were of opinion that all the gas-lamps on the line of existing cables should be converted to electric Nernst lighting, and that a type of lantern designed by the Electrical Engineer should be adopted, at an estimated cost of £1 17s. 6d. per lamp. The total estimated cost for the 135 lamps is £582. The Committee were further of

opinion that the whole of the remaining lamps having flat-flame burners should be changed to incandescent gas lighting, the lanterns to be the Edgar 16-inch special type. The cost of such alterations works out at £1647. The annual payments to the Gas Company (excluding the paving charges) would therefore be £324. The paving charges, estimated at £26, would have to be paid by the Council during the current year. The Committee thought it very desirable that the Gas Company should undertake the repairing and painting of the lamps so that there should be no divided responsibility. They considered the terms offered by the Company fair and reasonable, and advised their acceptance.

Finally, the Committee recommended: (1) That 135 flat-flame burners in forty side streets on the line of existing cables be converted to Nernst electric lamps at a total estimated cost of £582. (2) That the remaining flat-flame gas-lamps in the borough—1016 one-burner, 8 two-burner, and 2 three-burner lamps—be converted to incandescent gas, and fitted with 16-inch lanterns, burners, &c., made by Mr. William Edgar, at a total estimated cost of £1647. (3) That the offer of the Gaslight and Coke Company to carry out the work in connection with the conversion of the lamps (with the exception of the paving work to be executed by the Council), and to spread repayment over twenty equal quarterly instalments free of interest, be accepted. (4) That the offer of the Company to light, extinguish, clean, repair, paint, and maintain all the incandescent street-lamps in the borough, be accepted at the following rates: Lighting, extinguishing, and cleaning, one-burner lamps 18s. 6d., two-burner lamps £1 3s., three-burner lamps £1 5s.; maintaining mantles, mantle-rods, and chimneys 6s., 12s., and 18s. respectively; and repairing and painting 4s., 10s., and £1 respectively.

Mr. Cook, in moving the adoption of the report, said that though the Nernst lamps would cost a little more than gas, they would be a good advertisement. During the peak hours, the cost was only 1d. per unit; and for the remaining hours of the day it was ½d. per unit, which would reduce the cost to 12s. 6d. per lamp; so it would really be cheaper than gas. He thought the Committee were wise in not recommending that the whole of the borough be lit with electric light, but only where cables were already laid. The present cost of lighting the borough was £3612; and with the Nernst lamps it would be £3799, or an increase of only £187. The present aggregate was 15,000-candle power; and with the new lamps it would be something like 83,000 candles. Fulham was the only borough still lit with flat-flame burners; and there were many complaints. If the Committee's recommendations were carried, the complaints would cease; and Fulham would be one of the best lighted boroughs in the country.

Mr. Easton regretted that no cognizance had been taken of the tests made in his presence, when it was shown that the Nernst lamps gave no better light than the incandescent. He hoped the Council would consent to fix incandescent burners to all the lamps. Two laundries had motors which they could not work owing to the insufficiency of pressure in the mains. He did not think they should rob private consumers of current and use it for public lighting. He moved that the first recommendation be referred back.

Mr. Sainsbury pointed out that Mr. Easton was present when the first tests were made, which proved the superiority of the Nernst lamps. Not satisfied with that, he made private tests himself, at a less distance from the gas-lamps, but at the same distance from the Nernst lamps.

The amendment was defeated, and the Committee's recommendations adopted.

THE PRESENT POSITION OF GAS.

Mr. Charles Hunt's Views.

Last Friday, the "Evening Standard and St. James's Gazette" published the following statement of the views of Mr. Charles Hunt with regard to the position of the gas industry.

"I think," Mr Hunt said, "that there is no doubt now as to the superiority of the incandescent gaslight over the electric light. Of course, we do not deny that electric light has hit the gas companies in the past. The tendency nowadays, perhaps, is for the consumer to use gas more for heating purposes and generating motive power. Our endeavours consequently now are to increase the heating properties of our gas, and to decrease its lighting power. The incandescent burner, which has nearly superseded the old flat-flame burner altogether, requires heat to make it brilliant; and therefore it is obviously to our advantage to reduce the candle power of our gas. What we want is a fair field and no favour. Local authorities in many cases are apt to choose electricity rather than gas as an illuminant by the fact that they have their own electricity plant. Ipswich and Liverpool, however, have decided for gas lighting, though the Corporation in each place have their own electricity works. In one town of which I know, the rate for lighting has gone up from 6d. to 11d., owing to the electric lighting, though only a quarter of the area formerly lit by gas is electrically illuminated."

Mr. Hunt then showed how great the progress of the gas industry had been during the last 23 years by the following figures:

	Capital Invested.	Consumers.	Number of Public Lamps Lighted.
1882. . . .	£50,261,118 ..	1,971,971 ..	361,311
1905. . . .	£124,184,221 ..	5,064,175 ..	665,791

These increases had been the result, he pointed out, of a progress which was continuously steady; and the figures, though not including the returns of the smaller companies, were fully representative of the industry as a whole.

Cheaper Gas for Power at Hereford.—The Hereford City Council, on the recommendation of the Gas Committee, have reduced the charge for gas supplied for motive power. The prices in future will be: Under 25,000 cubic feet per quarter, 2s. 3d. per 1000 cubic feet; over 25,000 and under 50,000 feet, 2s.; and over 50,000 feet, 1s. 9d.

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EARLY GAS LIGHTING IN LONDON.

An Extract from the "Monthly Magazine."

After alluding to the fact that on June 4, 1807, London was favoured with its first public demonstration of the practicability of adapting coal gas to street lighting, the "Financial News" gives the following account of the experiment as published in the "Monthly Magazine" for July, 1807.

"On Thursday evening, the 4th of June, the first public exhibition of Mr. Winsor's gas lights took place, in honour of his Majesty's birthday, in the lighting of a great length of lamps, similar to the side of a street, at a considerable distance from the carbonizing furnace. This experiment was made on the wall which separates the Mall in St. James's Park from Carlton House Gardens. The works had been for some time in preparation; and private trials had previously been made to prove the air-tightness of the tubes of communication, which were of tinned iron, with soldered joints, except at certain distances, where they are otherwise cemented together for the convenience of removal. The diameter of the long pipe is 1½ inches. It commences in the two close carbonizing iron furnaces in Mr. Winsor's house in Pall Mall—one capable of containing and coking 4 pecks, and the other 2 pecks of common pit or sea coal—and, by the means of stopcocks, one or both of these furnaces can be made to send its gas into the pipes above mentioned, which first proceed south, about 10 yards underground, until they enter the Prince of Wales's Gardens belonging to Carlton House. From hence the pipe proceeds west for about 140 yards, rising gradually against the garden wall, to which it is affixed, until it arrives at the north-west corner of the garden, whence it is conducted 150 yards south, on the top of the wall which separates the Prince's from Marlborough House Garden, to the door at the south-west corner of Carlton Gardens.

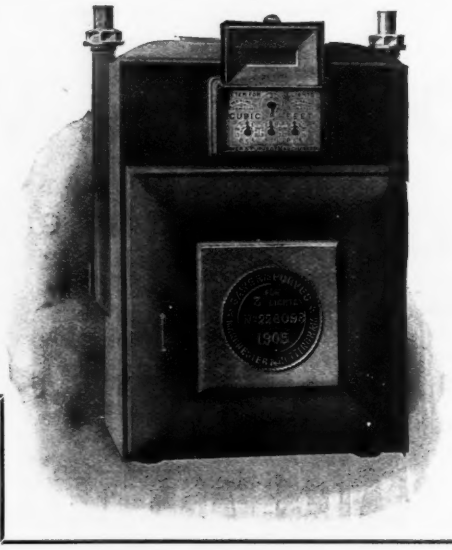
"Here the first light, or illumination, was produced by a thin and broad stream of gas from a small tube or branch from the pipe, which gave a very brilliant light in the open air without a glass cover. From this point, the communicating-pipe proceeded along the top of the wall for 250 yards in an east direction, to the private door in the wall opening into the Mall, having on it 32 tubes or burners enclosed in glasses of different shapes and constructions, and some naked burners without glass covers. On one of the piers of this private door a four-branch burner, with reflectors, in imitation of the Prince's feathers, had a very pleasing and appropriate effect. From this private door, the tube proceeded 50 yards further withinside of the wall, to the back gates of Carlton Gardens, and there terminated in a grand transparency erected over the gateway, consisting on one side of a number of cut-glass stars and other devices, with gas lights behind each, besetting the crown and letters 'G.R.' The inflammable gas, which is quite transparent or invisible, began to flow in the pipes soon after 8 o'clock; and a lamplighter, or person with a small wax taper (the evening being quite serene), appeared and lighted the gas issuing from each burner in succession. Some time after a very large burner or assemblage of small streams of gas was lighted on the top of the transparency, which was not, however, illuminated for a long time afterwards. The light produced by these gas-lamps was clear, bright, and colourless; and from the success of this considerable experiment in point of the number of lights, the distance and length of pipe, hopes may now be entertained that this long-talked-of mode of lighting our streets may at length be realized. The Mall continued crowded with spectators until near 12 o'clock; and they seemed much amused and delighted by this novel exhibition."

COALITE FINANCE.

The "Financial News" gives the following information regarding the finances of Coalite Limited: The original capital of the Coalite Company was only £55,000, in 50,000 ordinary shares of £1 each, and 100,000 deferred shares of 1s. each. The Company was registered on July 20, 1906, to carry on, in the United Kingdom or elsewhere, the business of colliery proprietors, iron and coal masters, miners, producers, refiners, suppliers and distributors of mineral oils, chemical manufacturers, ironfounders, dealers in machinery and apparatus for manufacturing and improving the illuminating or heating power of gas, spirit oil, petroleum, and the like, gas makers, and dealers in coal, and to adopt an agreement with Thomas Parker. The Company did not issue to the public any invitation to subscribe for its shares; but the articles provide that should any of the shares be so offered at any time, the minimum cash subscription upon which the Directors may proceed to the first allotment shall be £100. Half the profits available for distribution are to go to the ordinary shareholders and half to the deferred. In the event of winding up, each class of shareholders will be entitled to half of any surplus assets. Each share confers one vote, irrespective of class. The first Directors were Messrs. J. H. Smith and J. Conchie. Mr. C. Allen, J.P. (Chairman of Henry Bessemer and Co., Limited), joined the Board in January last, and Messrs. A. G. Kitching, J.P. (Director of the Metropolitan Railway Company), and F. R. Pelly (Director of William Cory and Son, Limited) were appointed as additional Directors late in May.

The agreement as above mentioned has been filed. Under it, Mr. Thomas Parker (the vendor) agreed to sell to the Company certain processes, inventions, and provisional protections for the United Kingdom and the Isle of Man, relating to fuel, with benefit of all improvements, the consideration being 100,000 deferred shares, credited as fully paid (to be allotted to the vendor or his nominees). The deferred shares were allotted on Oct. 31, 1906, as follows: 25,000 to T. Parker and 75,000 to G. W. M. Adams. If it is correct that Mr. Salisbury Jones received a large portion of these deferred shares in consideration of his providing part of the original capital, his shares are presumably

DRY GAS METERS.



ALL SIZES STOCKED

SAWER & PURVES,

MILES PLATTING, MANCHESTER.

RADFORD ROAD, NOTTINGHAM.

included in those held by Mr. G. W. Adams. As regards the ordinary shares, 5000 were allotted (payable in cash) on July 25, 1906, £10,270 during October, 1906, and 34,723 on Nov. 21 last to some two dozen subscribers. No further list of allotments or "summary of capital and shares" has been filed; and no notice of the increase of capital to £2,000,000, which is said to be pending, has been placed on the file at present.

A correspondent of "Coal and Iron," who pays a high tribute to Mr. Thomas Parker, the inventor of Coalite, doubts if there is much demand for smokeless fuel. He remarks: "Of course, Mr. Thomas Parker, of Wolverhampton, is a well-known man. He has been connected with electrical, copper, and other industries for many years past, and is known to be of a very inventive turn of mind. But we have nothing new in Coalite except the name. Twenty hundredweight of small coal, by a process of wet distillation, produces about 15 cwt. of an artificial anthracite, now named 'Coalite,' by eliminating the hydrocarbon gases and the lighter hydrocarbons and ammonia in the tar and liquor. Now, we all know that on sentimental grounds smokeless coal has its charms; but the consumer, as every retail coal merchant knows, will have none of it. He wants a coal that will give plenty of flame and plenty of heat. By taking the gas, ammonia, and tar out of the coal, you eliminate the flame. We all know what strenuous efforts have been made for years past, by certain firms in the trade, to get the coal consumer to adopt anthracite—and with what poor results. The difference between Coalite and anthracite is simply that anthracite has been formed by natural processes, while Coalite is formed by an artificial process; the one has been compressed by earth pressure, the other, not having been compressed, is porous."

Wolstanton and Burslem's Gas-Mains.—In calling attention to the minutes of a special meeting held to discuss the gas question, the Chairman of the Wolstanton Urban District Council (Mr. C. H. Bowers) said that, inasmuch as the particulars given by Burslem were not sufficient to enable the Council to make an offer for the mains to be taken over, it was deemed expedient on the part of the Council to appoint an arbitrator. Newcastle had furnished information which would enable the Council's valuers to make an offer; and it was regrettable that the Corporation of Burslem had not done the same.

A Gratifying Report at Neath.—The minutes of the Gas Committee presented at last Tuesday's meeting of the Neath Town Council included the annual report of the Engineer and Manager (Mr. R. A. Browning), which stated that, though less coal had been carbonized, 2 million cubic feet of gas more had been made last year than in the preceding twelve months, and over 4 million cubic feet more had been sold. This extra sale was in spite of the Council adopting electricity in place of gas for 200 public lamps. The gross profit for the year was £5224—a reduction of £143 on the preceding year. It was decided to dispose of the profit as follows: Interest on loans, £1304; repayment of capital, £2075; relief of the rates, £1000; suspense account, £846.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

It is announced to-day that the Contracts Sub-Committee of the Glasgow Corporation Gas Committee met yesterday to consider the tenders for the supplying of coal for gas-making purposes during the ensuing year, and that it was resolved to purchase, provisionally, the whole of the requirements, amounting to 748,000 tons. It is understood that the prices average something over 3s. per ton more than those at which the previous year's contracts were arranged. The higher prices would involve an increase of 5d. per 1000 cubic feet in the cost of producing gas; but it is believed that, owing to certain economies which are to be effected, and the return from bye-products, the increase will be only 3d. The Committee have bought less of the dearer coking coal, and more ell and splint, than was the case last year. They have purchased about 200,000 tons of shale; and the balance, roughly some 450,000 tons, consists of splint and ell, in nearly equal quantities—about 30,000 tons more of the former being accepted than of the latter.

The Dundee Gas Committee on Monday considered the report and estimates, a summary of which was published in the "JOURNAL" last week (p. 677). It was resolved to retain the price of gas, notwithstanding an increased charge of over £10,000 for coal, at the present rate of 2s. 6d. per 1000 cubic feet. It was explained that an increase was only staved off by the most careful handling of the estimates. Bailie Crichton pointed out that a sum of only £1050 had been allowed for retorts and setting, as against £2358 last year; £1200 for gas-stove repairs and fitting, as against £2010; and £2200 for main and service pipe repairs, as against £4073. He asked if, having regard to these large reductions, the allowances proposed in the estimates were sufficient to meet requirements, and expressed the hope that the plant and the undertaking would not suffer in consequence. It was stated, in reply, that the expenditure upon repairs in these departments had for some years been abnormal, and that, having regard to the present state of efficiency of the plant, the allowances which had been made would suffice. Attention was also directed to the fact that on the income side of the estimates, allowance was made for an increased revenue from residual products and the like of about £3000. The Manager—Mr. A. Yuill—gave it as his opinion that the estimates were well within the mark. The capital debt, it was stated, was £7000 less than last year. The estimates were approved.

Mr. J. T. R. Wilson, the Convener of the Cleansing and Lighting Committee of the Edinburgh Town Council, has formulated his proposals—announced some time ago—for dealing with the problem of the lighting of the streets and common stairs in the city. At present the inhabitants light the lamps on the stairs, and the lamplighter staff extinguish them at sunrise. The lamps thus burn during all the hours of darkness. Mr. Wilson's proposal is that from April 1 to Sept. 30, the stair lights are to be extinguished at midnight, and during the

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winter months at sunrise, as at present. The financial results are stated as follows: Wages of 90 men or lads, at 10s. per week, £2340; wages of additional ten men, £598—a total of £2938. Against this there will be a saving of gas in the street-lamps equal to £1864, in stairs equal to £2578, and in the Cleansing Department equal to £72—a total of £4514, and bringing out an annual saving of £1576. The Committee approved of the proposals; but improved upon them, to the extent of recommending that from May to August only half of the street-lamps be lighted, which would effect a further saving, and make it up to nearly £2600. The Town Council have yet to approve of the scheme.

In the Kirkcudbright Town Council last week, the Gas Manager reported that the income of the department for the year ending May 15 amounted to £1332, of which £1186 was for gas sold. The expenditure amounted to £1032; but there was stock in hand of the value of £224. There was thus a surplus on the year's working of £524. Mr. Brown, in moving the adoption of this report, said the Gas Committee had considered the further reduction of 5d. in the price of gas; but owing to the high price of coal, this was out of the question now.

The annual meeting of the Meigle Gaslight Company was held on Saturday last. A dividend at the rate of 3½ per cent. was declared; and it was intimated that, on account of the great increase in the cost of coal, there would be no further reduction in the price of gas in the meantime.

The annual general meeting of the Comrie Gaslight Company was held on Tuesday—Sir Charles H. Dundas, of Dunira, presiding. A dividend at the rate of 1s. per share—the same as last year—was declared.

The Gas Committee of the Peterhead Town Council reported on Monday that they had had before them tenders for coal for the year, and that they had adopted the selections of the Manager—Mr. W. Ritchie. It was explained that the rise in price amounted to 3s. per ton on an average. This would have necessitated an increase in the price of gas of 2d. per 1000 cubic feet; but, through the forethought of the Manager, they would be able to keep the price as at present.

In the Town Council of Aberdeen on Monday, the Water Committee recommended that Sir Alexander R. Binnie, M.Inst.C.E., Mr. G. R. Strachan, M.Inst.C.E., and Dr. A. C. Houston, Director of Water Examinations to the Metropolitan Water Board, be requested to report upon the subject of a new or additional water supply for the city. Mr. Wilson, for the Convener of the Committee, said that the recommendation was put forward because of the objections of a minority of the Council to the Avon water scheme. They already had Mr. Hawksley's report, which they were not to throw overboard. They were simply to ask the advice of other experts as to the best water supply for the city. Mr. Hawksley had been consulted in the matter; and he approved of the names put forward. The Council, after discussion, adopted the recommendation.

At the end of last week, the Town Council of Montrose celebrated the fiftieth anniversary of the introduction of a water supply to the burgh. The party drove to Kinnaber, where the station for pumping water from the River North Esk is situated. The works were inspected; and thereafter dinner was served—Mr. Hall, the Convener of the Water Committee, presiding. Replying to the toast of his health, the Chairman said that the original works were established in May, 1857. The cost was £8242, and down to the present time the additional outlay had been about £10,000. In his opinion, the Council had not yet nearly exhausted the resources for augmenting the water supply.

CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia.

LIVERPOOL, *June* 8.

There has been rather less activity in the market, but the demand has been fairly well maintained, and supplies are being absorbed as they become available. Prices at the different ports, however, show considerable irregularity; the closing quotations being £11 16s. 3d. per ton f.o.b. Hull, and £12 per ton f.o.b. Liverpool, while at Leith, available supplies being scarce, £12 2s. 6d. per ton is required. There has been less doing in the forward position, the extreme firmness of makers checking business. For July-December delivery £12 2s. 6d. per ton is quoted, but this is 2s. 6d. per ton above buyers' ideas; and £12 5s. per ton quoted for spring months places that position out of reach.

Nitrate of Soda.

This article is firmer on spot; the quotations being 10s. 9d. per cwt. for 95 per cent., and 11s. for refined quality.

Tar Products.

LONDON, *June* 8.

Markets for tar products still remain quiet; and there is not much alteration in prices, though, with the exception of one or two of the refined products, they are very steady all round. In creosote, there is considerable activity. In pitch, makers are very firm in their ideas regarding forward delivery; but until there is a move on the part of buyers on the Continent, it is improbable that dealers will be able to pay the prices at present asked, which are practically 30s. all round, though some makers would doubtless accept a firm offer of 29s. if same were made to them. For prompt delivery, London is still nominally 26s. 6d., though there is really hardly any to sell. On the east coast, sales continue to take place at prices varying at from 25s. 3d. to 25s. 9d.; and on the west coast, from 24s. to 25s. Creosote is firm. London makers now ask from 2⅝d. to 2¾d. for prompt, and 3d. for forward delivery. In the North, 2½d. to 2⅝d. is quoted; and in the Midlands, 2¼d. to 3d. There is plenty of inquiry for this article; and there is every indication that prices will at any rate be maintained, even if they do not go still higher. Benzol, 90 per cent., is very quiet, and 9d. has been accepted in London, casks included, delivered to consumers' works, though this was for a country quality; London manufacturers being well sold and firmer in their ideas. Benzol, 50-90's, is easy. The aniline makers appear to be well bought, and not inclined to buy any further quantities, except at very low prices. Toluol is difficult to sell, and there does not seem to be much demand

PARKINSON'S

COOKERS.

NEW DESIGNS.

Particulars on Application.

PARKINSON AND W. & B. COWAN, LTD.
(*Parkinson Branch*),
COTTAGE LANE, CITY ROAD, LONDON.
BELL BARN ROAD, BIRMINGHAM.

for this article at the present time. Solvent naphtha is quiet. In the North, several parcels have been sold at low figures for prompt delivery; but it is firm in London, owing to manufacturers being well sold. Carbolic acid is firm, though there does not appear to be much disposition to buy on the part of actual consumers. Probably the business which has been transacted in the past few days has been done by dealers, who wish to cover themselves in for the quantities which they are oversold. Naphthalene and creosote salts are in good demand. In anthracene, there is very little business doing.

The average values during the week were: Tar, 15s. 6d. to 19s. 6d. Pitch, London, 26s. 6d. nominal; east coast, 25s. 3d. to 25s. 9d.; west coast, 24s. 3d. to 25s. 3d. Benzol, 90 per cent., 8¼d. to 9¼d.; 50-90 per cent., 9½d. to 10d. Toluol, 1s. 0¾d. to 1s. 1½d. Crude naphtha, 4⅜d.; solvent naphtha, 1s. 1d. to 1s. 3½d.; heavy naphtha, 1s. 2d. to 1s. 4d. Creosote, London, 2⅜d. to 2⅝d.; North, 2¼d. to 2 9/16d. Heavy oils, 3d. to 3 1/16d. Carbolic acid, 60 per cent., 1s. 8d. to 1s. 8¼d. Naphthalene, £6 10s. to £10 10s.; salts, 35s. to 40s. Anthracene, "A" quality, 1⅛d. to 1⅜d.

Sulphate of Ammonia.

The market has been steady during the past week; but there does not appear to have been so much eagerness to buy as was the case about ten days ago. Values are, however, well maintained, and the general impression seems to be that before long we shall see an improvement. The principal London Gas Companies still quote £12 2s. 6d. to £12 5s.; but other makes could be bought upon their special terms at £11 15s. to £11 17s. 6d. In Leith, the market is nominally £12, though it is doubtful whether makers would sell any considerable quantity at this figure—they wanting £12 2s. 6d.; while for forward delivery they are asking £12 5s. In Liverpool, £11 17s. 6d. to £11 18s. 9d. is taken to be about the market value; while in Hull, where the market is still quiet, £11 15s. would be accepted by anybody who wished to dispose of a parcel.

COAL TRADE REPORTS.

Lancashire Coal Trade.

The general condition of the coal trade throughout the county and in the Midlands continues firm. High prices rule, so much so that an attempt has been made by a section of the Liverpool City Council to break down the alleged combination among coal owners to keep prices up. At Manchester, the notion has been pooh-poohed. In South Yorkshire, engine coal contracts are being dealt with just now, and 12s. per ton seems to be the lowest price. The demand for all kinds of coal in Lancashire continues good. Pits are everywhere working full time. Railway transit of coal waggons has improved, but there is still cause for dissatisfaction.

Northern Coal Trade.

The coal trade is generally very brisk, though there are one or two collieries that have been less active, owing to the non-arrival of steamers in time. The shipments are fairly full for the season; and the range of prices seems to be maintained nearly all round. In the steam coal trade, best Northumbrians are quoted from 14s. 9d. to 15s. per ton f.o.b., second-class steams are from 14s. to 14s. 3d., and steam smalls are firm at from 10s. to 10s. 3d. The output is well kept up, and there is a demand above that which is usual at this season. In the gas coal trade, the request for export is very heavy, especially for some of the near Continental countries. Good Durham gas coals are even firmer in price—varying from about 13s. to 14s. 6d. per ton f.o.b. for occasional cargoes, while deliveries are still being made on long contracts at much less. There are both home and foreign contracts in treaty; and for the former, it is expected that about equal to 13s. per ton f.o.b. will be agreed upon. There are rumours, however, that for a south-country contract of some 40,000 tons, about 12s. 6d. per ton for second-class coals has been accepted; but something depends on the allowance made for the freight, which varies. The gas coal market must be looked on as strong, especially for early delivery, and large cargoes are being sent abroad. The coke trade is firmer; and gas coke is steady, though fairly plentiful for this season, at about 13s. to 13s. 3d. per ton f.o.b.

Scotch Coal Trade.

The coal market is active, the demand for small stuffs for shipping being very great. Now that the coal contracts for the Glasgow Corporation Gas Department have been settled for the year, a great cause of excitement has been removed from the market. Were it not for the possibility of trouble with the miners, an easing off of prices might safely be predicted. The prices quoted are: Ell 12s. to 13s. 6d. per ton f.o.b. Glasgow, splint 12s. to 12s. 6d., and steam 11s. 9d. to 12s. The shipments for the week amounted to 310,744 tons—a decrease of 1970 tons upon the preceding week, but an increase of 71,937 tons upon the corresponding week of last year. For the year to date, the total shipments have been 5,804,735 tons—an increase of 291,192 tons upon the corresponding period of 1906.

Blackburn Gas Department.

The abstract of the accounts relating to the Blackburn Gas-Works for the year to March 25 shows that the total income was £116,892, against £116,041 for the previous year; while the expenditure was £75,272, compared with £69,662. The balance carried to net revenue account was £41,620. Interest on stock and loans absorbed £22,096, bank interest £286, and sinking fund charges, &c., £10,303. The balance of £8935 has been carried to reserve fund account. The gas made was 703½ million cubic feet; about 53½ million feet, or 7·6 per cent., of which was unaccounted for. The make for the previous year was 640 million feet. The make per ton was 10,565 cubic feet. The cost of coal and oil per ton of coal carbonized was 11s. 3·02d.; while the residuals realized 5s. 6·02d., leaving the net cost of coal 5s. 9d. per ton, or 7·16d. per 1000 cubic feet of gas sold. Coal and working expenses, less residuals, were 20·49d. per 1000 feet sold, while the rental and lamps equalled 35·47d.; so that there was a profit of 14·98d. per 1000 cubic feet of gas sold.

CARRON COOKERS.

CARRON COMPANY · STIRLINGSHIRE · FOUNDED 1759 · INCORPORATED BY ROYAL CHARTER 1773

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Hired out by all the leading Gas Companies and Corporations.

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INCORPORATED BY ROYAL CHARTER 1773

WORKS: CARRON, STIRLINGSHIRE.

West Bromwich Corporation Gas Department.

At the monthly meeting of the West Bromwich Town Council, the Mayor (Mr. J. E. Wilson) commented upon the annual report of the gas undertaking (see *ante*, p. 601). He pointed out that the net profit (£5107) was an increase of £87. Last year they reduced the price of gas, which had decreased their revenue to the extent of £1320. Of the profit, £1000 was to be handed over to the relief of the district rate. He believed they had pursued the right policy in increasing the capacity of the works out of revenue; and they had reduced the debt by £8632, leaving a net debt of £136,966, or a little more than one-half the actual amount expended on the works. The outlook so far as the rising price of coal was concerned was not very satisfactory; but they hoped to get through this year without any great additional expense in the matter. But they had to face the probability that next year they might have to pay more for the coal. He mentioned that considerable extensions in connection with the accommodation for storage of gas might be necessary in the near future, and he suggested an amalgamation with the Electricity Committee of the Corporation in providing a suitable outdoor department in a central position in the borough which would prove advantageous to both concerns. He acknowledged the able services the Committee had received in carrying on the business from Mr. H. E. Copp, the Manager, and Mr. T. Hudson, the Secretary.

Reduction in Price at New Mills.—The New Mills District Council, for the fourth year in succession, have reduced the price of gas 1½d. per 1000 cubic feet, making it 3s. per 1000 feet to ordinary consumers. There is a sliding-scale for large users. For gas-engines, the charge is 2s. 6d. per 1000 cubic feet.

Sales of Shares.—At the Auction Mart, Tokenhouse Yard, last Tuesday, Mr. Alfred Richards sold, by order of the Directors, £50,000 of 4 per cent. capital stock of the Commercial Gas Company. Every lot was disposed of; the prices realized ranging from £103 to £105 per £100 of stock. Recently Messrs. Guy and Son sold by auction locally 7 fully-paid £10 original shares in the Hailsham Gas Company, which realized £10 17s. 6d. and £11 2s. 6d. each. At the same time, 27 fully-paid £10 shares in the Hailsham Water Company were disposed of at prices ranging from £10 10s. to £11 each.

Exeter Water Supply.—The accounts of the Exeter Water-Works for the year ending March 25 show that the net profit realized was £1212, which it is proposed to transfer to the general district fund in aid of the rates. It is pointed out that the profit would have been greater but for the fact that a sum of £347, which it was intended to pay out of capital, had been charged to the revenue account. Of the net revenue of £10,000, the sum of £5281 had to be deducted for interest on loans, and £3039 for sinking fund. It is proposed to cover the reservoirs at Danes Castle and Marypole Head, at a cost estimated at between £6000 and £7000.

Dearer Gas for Dukinfield.—At the May meeting of the Dukinfield Town Council, it was reported that the past year's working of the gas undertaking had resulted in a loss of £240; and an increase of 2d. in the price of gas (making it 2s. 9d. per 1000 cubic feet) was proposed. The matter was, however, referred back to the Gas Committee, who again brought forward the proposal at last week's meeting of the Council. The question was then threshed out; and on a division, nine voted for the increase and nine against. The Mayor thereupon gave his casting-vote for the resolution; so that the 2d. which was taken off the price of gas twelve months ago will be restored to it.

Lincoln Gas Supply.—Alderman Wallis, the Chairman of the Lincoln Gas Committee, dealing with the working of the undertaking during the past twelve months, informed the City Council that the gas sold was about the same as in the previous year. The returns from residuals had gone down during the past three years; but he hoped they had now reached bottom. The gross profit was £12,611. They had spent in new mains and cooking-stoves £681 out of profits; while they had also paid £4000 towards the relief of the rates, which left them £838 10s. 11d. to carry forward. Another satisfactory feature was that the concern now stood £89,308 to the good; the total liabilities being £160,073, and the assets £249,381. He could not give any forecast of the results of this year's operations, as they did not know what the price of coal might be.

The Tavistock Urban District Council have decided to borrow the sum of £275, to cover the cost of re-arranging the public lights, fitting incandescent burners, and improving the lighting.

The Kirkham Gas Company have placed an order with Messrs Robert Dempster and Sons, Limited, of Elland, for a steel tank and holder. The work has to be carried out under the supervision of the Company's Manager, Mr. J. Crook.

The Corporation of Luton have achieved the distinction of building what is believed to be the largest reservoir in ferro-concrete that has been erected in this country. The total storage capacity will ultimately be 2¼ million gallons; that of the first portion, now completed and brought into use, being 2 million gallons.

At a Domestic Trades Exhibition at the Burton-on-Trent Town Hall, a feature was a fine display (particularly by Messrs. George Bray and Co., of Leeds) of incandescent gas-fittings, including upright and inverted burners. The exhibition also included a number of gas-cookers; and a series of cookery lectures was among the attractions.

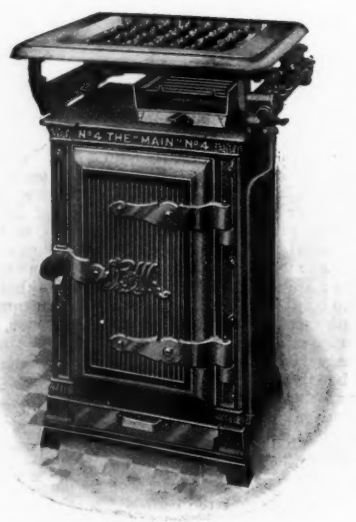
It is announced that claims for compensation have been made to the Shoreditch Borough Council in connection with the recent gas accident by which, as already recorded in the "JOURNAL" (pp. 606, 681), a Mrs. Choate lost her life and a number of other persons were more or less affected. The Town Clerk (Dr. H. Mansfield Robinson) has pointed out to the Council that he attended the inquest; and there was no evidence of negligence by the Council's officers. The Jury returned a verdict of "Accidental death," without adding any recommendation or suggestion. The matter has been referred to the Law and Establishment Committee for consideration.

SEASON 1907.

The "MAIN"

Gas

Cookers



High Grade Cookers.

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R. & A. MAIN, LIMITED,

LONDON, GLASGOW, AND FALKIRK.

ALSO AT

BIRMINGHAM, BRISTOL, MANCHESTER, MELBOURNE, AND SYDNEY.

Messrs. Arden Hill and Co., of Birmingham, have just issued a new illustrated catalogue (consisting of nearly 200 pages) of their well-known gas cooking and heating apparatus. Though not absolutely a "waistcoat pocket" book, the dimensions of the pages are such as make it a very handy size. Convenience is further studied in the provision of a thumb index, by means of which any of the fifteen sections of the book can be referred to instantaneously without any turning over of pages.

LEAFLETS FOR DISTRIBUTION.

"ILLUMINATING TRUTHS FOR HOUSEHOLDERS."

No. 1.—"The Sanitary Aspects of Gas and Electric Lighting."
No. 2.—"The Cleanliness of Illuminants: The Eyesight."
No. 3.—"Fire Risks."
No. 4.—"The Relative Cost of Gas and Electricity, and Matters affecting it."
No. 5.—"On Reliability, with Instances of Misplaced Confidence."
No. 6.—"On Shop Lighting, with Special Reference to the Flame Arc Lamp."

This series of Leaflets will be useful, not only for distribution among Householders generally, but for circulation among Shareholders to fortify them with arguments in defence of the commodity in which they have invested capital. Copies of each Leaflet should also be kept in every Gas Undertaking's Show-Rooms.

Prices for Quantities on Application to WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

MANAGER. Banbury Gas Company. Applications by June 25.
MANAGER. Leek Urban District Council. Applications by June 24.
FOREMAN (COKE-OVENS). No. 4785.
YARD FOREMAN (Hong Kong). No. 4782.
GAS FITTER (Hong Kong). No. 4782.

Situations Wanted.

FOREMAN BYE-PRODUCTS WORKS. No. 4783.
REPRESENTATIVE GAS PLANT MANUFACTURERS IN CANADA. No. 4784.

Gas Manufacture Correspondence Classes.

CORRESPONDENCE COLLEGE COMPANY, CAMBRIDGE.

Plant (Second-Hand), &c., for Sale.

STATION METER. The Gas Meter Company.
WASHER-SCRUBBER. Deal and Walmer Gas Company.

Meetings.

INSTITUTION OF GAS ENGINEERS. Dublin. June 18, 19, and 20.

Stocks and Shares.

ASCOT GAS AND ELECTRICITY COMPANY. June 24.
BRENTFORD GAS COMPANY. June 24.
CHIGWELL, LOUGHTON, AND WOODFORD GAS COMPANY. June 18.
CROYDON GAS COMPANY. June 18.
ELSTREE AND BOREHAM WOOD GAS COMPANY. (Debentures.)
LEA BRIDGE GAS COMPANY. June 24.
LONDONDERRY GAS COMPANY. June 24.
NEW CONVEYOR COMPANY. No. 4781.
SOUTHEND WATER COMPANY. June 24.
SOUTH ESSEX WATER COMPANY. June 18.
WALKER AND WALLSEND GAS COMPANY. June 14.
WANDSWORTH AND PUTNEY GAS COMPANY. June 18.

TENDERS FOR

Brass Cocks, Fittings, Valves, &c.

HALIFAX GAS DEPARTMENT. Tenders by June 18.
PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

Coal and Cannel.

ATHERTON URBAN DISTRICT COUNCIL. Tenders by June 19.
BAKEWELL GAS DEPARTMENT. Tenders by June 25.
BOLTON GAS DEPARTMENT. Tenders by June 28.
BRIDGNORTH GAS DEPARTMENT. Tenders by June 17.
BURY GAS DEPARTMENT. Tenders by June 15.
CARLISLE GAS DEPARTMENT. Tenders by June 25.
CARNARVON GAS DEPARTMENT. Tenders by June 20.
CIRENCESTER GAS COMPANY. Tenders by July 3.
COLWYN BAY AND COLWYN GAS DEPARTMENT. Tenders by June 26.
DARLINGTON GAS DEPARTMENT. Tenders by June 22.
DEWSBURY CORPORATION. Tenders by June 22.
DROITWICH GAS DEPARTMENT. Tenders by June 20.
EXMOUTH GAS COMPANY. Tenders by June 29.
HALIFAX GAS DEPARTMENT. Tenders by June 19.
HUYTON AND ROBY GAS COMPANY. Tenders by June 15.
KESWICK GAS COMPANY. Tenders by June 19.
KIDWORTH GAS COMPANY. Tenders by June 29.
LEAMINGTON PRIORS GAS COMPANY. Tenders by June 18.
LIMERICK GAS DEPARTMENT. Tenders by June 24.
LYMM GAS DEPARTMENT. Tenders by June 19.
MARKET HARBOROUGH GAS DEPARTMENT. Tenders by June 22.
NEWBURY GAS DEPARTMENT. Tenders by June 14.
NEWCASTLE-UNDER-LYME GAS DEPARTMENT. Tenders by June 20.
NEWRY GAS DEPARTMENT. Tenders by June 28.
PAIGNTON GAS COMPANY. Tenders by June 22.
PENRITH GAS DEPARTMENT. Tenders by June 19.
PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.
SAFFRON WALDEN CORPORATION. Tenders by June 24.
SHEFFIELD GAS COMPANY. Tenders by June 17.
SOWERBY BRIDGE GAS DEPARTMENT. Tenders by June 24.
SPALDING GAS DEPARTMENT. Tenders by June 18.
SUNBURY GAS COMPANY. Tenders by June 20.
TORQUAY GAS DEPARTMENT. Tenders by June 17.

Condensers.

COVENTRY GAS DEPARTMENT. Tenders by June 17.

Fire-Clay Goods.

PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

General Stores, Barrows, Lead Pipe, Oils, Paints, Ironmongery, Castings, &c.

PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

Incandescent Materials, Lamps, &c.

PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

Lime.

HALIFAX GAS DEPARTMENT. Tenders by June 18.
KEIGHLEY GAS DEPARTMENT. Tenders by June 17.
PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

Meters.

PONTYPRIDD GAS DEPARTMENT. Tenders by June 24

Oil for Gas Making.

SOUTHEND GAS COMPANY. Tenders by June 17.

Oxide of Iron.

HALIFAX GAS DEPARTMENT. Tenders by June 18.
KEIGHLEY GAS DEPARTMENT. Tenders by June 17.

Pipes, &c.

KEIGHLEY GAS DEPARTMENT. Tenders by June 17.
PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

Retort-Bench, &c.

WALSALL GAS DEPARTMENT. Tenders by June 28.

Sulphuric Acid.

HALIFAX GAS DEPARTMENT. Tenders by June 18.
KEIGHLEY GAS DEPARTMENT. Tenders by June 17.
PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.

Tar and Liquor, &c.

BAKEWELL GAS DEPARTMENT. Tenders by June 25.
BRIERLEY HILL GAS COMPANY. Tenders by June 21.
CARNARVON GAS DEPARTMENT. Tenders by June 20.
GREAT WESTERN RAILWAY. Tenders by June 25.
KESWICK GAS COMPANY. Tenders by June 19.
LYMM GAS DEPARTMENT. Tenders by June 19.
NEWARK GAS COMPANY. Tenders by June 20.
PONTYPRIDD GAS DEPARTMENT. Tenders by June 24.
READING GAS COMPANY. Tenders by June 24.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 717.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p.c.	20—21	..	5 0 0
268,324	10	,,	7½	Do. 7 p.c.	13¾—14½	..	5 3 5
200,000	5	May 15	7	Bombay, Ltd.	6¾—7	..	5 0 0
40,000	5	,,	7	Do. New, £4 paid	4⅞—5¼	..	5 6 8
50,000	10	Feb. 28	14	Bourne-mouth Gas and Water 10 p.c.	27¼—28½	..	4 18 3
51,810	10	,,	7	B 7 p.c.	16¾—17	..	4 2 4
53,200	10	,,	6	Pref. 6 p.c.	15—16	..	3 15 0
380,000	Stk.	,,	12½	Brentford Consolidated	245—250	−2	5 0 0
300,000	,,	,,	9¾	Do. New	188—193	−2	4 18 5
50,000	,,	,,	5	Do. 5 p.c. Pref.	117—122	..	4 2 0
206,250	,,	Dec. 13	4	Do. 4 p.c. Deb.	101—104	..	3 16 11
220,000	Stk.	Mch. 14	11½	Brighton & Hove Orig.	220—225	..	5 0 0
246,320	,,	,,	8½	Do. A. Ord. Stk.	160—165	..	5 0 0
460,000	20	Apl. 11	10	British	42½—43½	..	4 11 11
104,000	Stk.	Feb. 28	6	Bromley, Ord. 5 p.c.	119—122	..	4 18 4
165,700	,,	,,	4¾	Do. do. 3¾ p.c.	90—93	..	4 16 9
500,000	10	May 15	7	Buenos Ayres (New) Ltd.	11—11¼	..	6 1 9
250,000	Stk.	Dec. 13	4	Do. 4 p.c. Deb.	95—97	..	4 2 6
150,000	20	Mch. 14	8½	Cagliari, Ltd.	25—27	..	5 17 10
100,000	10	Sept. 27	10	Cape Town & Dis., Ltd.	12—14	..	7 2 10
100,000	10	Apl. 26	4½	Do. 4½ p.c Pref.	8¼—9¾	..	4 14 9
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	50—52	..	5 15 5
50,000	Stk.	Dec. 28	4½	Do. 4½ p.c. Deb. Stk.	96—98	..	4 11 10
157,150	Stk.	Feb. 28	5	Chester 5 p.c. Ord.	109—111	..	4 10 1
1,443,280	Stk.	,,	5⅛	Commercial 4 p.c Stk.	107—110	..	4 14 6
560,000	,,	,,	5	Do. 3½ p.c. do.	102—105	..	4 15 3
475,000	,,	Dec. 13	3	Do. 3 p.c. Deb. Stk.	83—85	..	3 10 7
800,000	Stk.	,,	6¼	Continental Union, Ltd.	115—120	..	5 8 4
200,000	,,	,,	7	Do. 7 p.c. Pref.	138—143	..	4 17 11
460,170	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	,,	Jan.	4	Do. Deb. Stk.	103—105	..	3 16 2
486,090	10	Jan. 31	12†	European, Ltd.	23½—24½	−½	4 18 0
354,060	10	,,	12†	Do. £7 10s. paid	18—19	..	4 14 9
15,203,110	Stk.	Feb. 14	4⅛	Gas-light 4 p.c. Ord.	90—92	−2	4 15 8
2,600,000	,,	,,	3⅛	3⅛ p.c. max.	87—89	..	3 18 8
3,799,735	,,	,,	4	and 4 p.c. Con. Pref.	101—104	−1	3 16 11
4,193,975	,,	Dec. 13	3	Coke 3 p.c. Con. Deb.	83—85	..	3 10 7
258,740	Stk.	Mch. 14	5	Hastings & St. L. 3½ p.c.	95—100	..	5 0 0
82,500	,,	,,	6½	Do. do. 5 p.c.	116—119	..	5 9 3
70,000	10	Apl. 26	11	Hongkong & China, Ltd.	15—20	..	5 10 0
4,940,000	Stk.	May 15	8	Imperial Continental	167—170	+1	4 14 2
473,600	Stk.	Feb. 14	3½	Do. 3½ p.c. Deb. Red.	93—95	..	3 13 8
184,602	Stk.	Mch. 14	6	Lea Bridge Ord. 5 p.c.	117—122	..	4 18 4
306,083	,,	Dec. 28	4	L'rpool Unit'd Deb. Stk.	110—112	..	3 11 5

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
561,000	Stk.	Feb. 28	10	Liverpool United A	223—225	..	4 8 11
718,100	,,	,,	7	Do. B	164—165	..	4 4 10
144,140	Stk.	Feb. 14	7⅞	Maidstone 5 p.c.	142—147	..	5 3 8
75,000	5	Nov. 29	5	Malta & Medn., Ltd.	4¼—4½	..	5 5 3
560,000	100	Apl. 2	5	Met. of 5 p.c. Deb.	100—102	..	4 18 0
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	100—102	..	4 8 3
541,920	20	May 30	3½	Monte Video, Ltd.	11—12*	..	5 16 8
1,775,892	Stk.	Feb. 28	4⅝	Newc'tle & G'tesh'd Con.	105—107	..	4 6 5
406,025	Stk.	Dec. 28	3½	Do. 3½ p.c. Deb.	96—97	..	3 12 2
15,000	10	Feb. 28	10	North Middlesex 10 p.c.	19¼—20½	..	4 17 7
55,940	10	,,	7	Do. 7 p.c.	13—14	..	5 0 0
300,000	Stk.	Apl. 26	8	Oriental, Ltd.	143—148	..	5 8 1
60,000	5	Mch. 27	7	Ottoman, Ltd.	6—6½	..	5 7 8
398,490	5	May 15	7	Primitiva Ord.	6⅞—7¼	..	4 16 7
796,980	5	Jan. 31	5	Do. 5 p.c. Pref.	5—5¼	..	4 15 3
488,900	100	June 1	4	Do. 4 p.c. Deb.	93—95*	..	4 4 3
1,000,000	10	Apl. 26	8	River Plate Ord.	12⅞—13⅛	..	6 0 9
312,650	Stk.	Dec. 28	4	Do. 4 p.c. Deb.	95—97	..	4 2 6
250,000	10	Mch. 27	8	San Paulo, Ltd.	12½—13	..	6 3 1
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	48—50	..	5 0 0
135,000	Stk.	Mch. 14	10	Sheffield A	245—247	..	4 1 0
209,984	,,	,,	10	Do. B	245—247	..	4 1 0
523,500	,,	,,	10	Do. C	245—247	..	4 1 0
70,000	10	Oct. 26	10	South African	15½—16½	..	6 1 3
6,350,000	Stk.	Feb. 14	5½	South Met., 4 p.c. Ord.	121—123	−1	4 9 5
1,895,445	,,	Jan. 16	3	Do. 3 p.c. Deb.	83—85	..	3 10 7
201,720	Stk	Mch. 14	8	South Shields Con. Stk.	157—159	..	5 0 8
605,000	Stk.	Feb. 28	5½	S'th Suburb'n Ord. 5 p.c.	120—123	..	4 9 5
60,000	,,	,,	5	Do. 5 p.c. Pref.	120—123	..	4 1 4
117,058	,,	Jan. 16	5	Do. 5 p.c. Deb. Stk.	125—130	..	3 16 11
502,310	Stk.	May 15	5	Southampton Ord.	105—110	..	4 10 11
120,000	Stk.	Feb. 28	6½	Tottenham A 5 p.c.	123—126	..	5 3 2
398,940	,,	,,	5	and B 3½ p.c.	101—103	..	4 17 1
137,500	,,	Dec. 28	4	Edmonton 4 p.c. Deb.	101—103	..	3 17 8
182,380	Io	,,	8	Tuscan, Ltd.	10½—11	..	7 5 6
149,900	Io	Jan. 2	5	Do. 5 p.c. Deb. Red.	102—104	..	4 16 2
193,742	Stk.	Feb. 28	5	Tynemouth 5 p.c. max.	105—107	..	4 13 6
30,000	Stk.	Feb. 14	8	Wandsworth A 5 p.c.	—	..	—
255,636	,,	,,	6½	B 3½ p.c.	133—138	..	4 14 2
75,000	,,	,,	5⅝	and C 3½ p.c.	—	..	—
79,416	,,	Dec. 28	3	Putney 3 p.c. Deb. Stk.	79—82	..	3 13 2
845,872	,,	Feb. 28	5⅛	West Ham 5 p.c. Ord.	102—105	..	4 17 7
185,000	,,	,,	5	Do. 5 p.c. Pref.	120—123	..	4 1 4
228,300	,,	Dec. 28	4	Do. 4 p.c. Deb. Stk.	102—105	..	3 16 2

Prices marked * are "Ex div." † Next dividend will be at this rate.

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LARGEST SALE OF ANY OXIDE,
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GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

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"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
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SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness, with efficiency for Repairs.
JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS BOLTON.
Telegrams: SATURATORS, BOLTON. Telephone 0848.

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BROTHERTON AND CO., LTD., Ammonia Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, WAKEFIELD, AND SUNDERLAND.

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SEND for Particulars of the "RAPID" Carburettor. Why be short of Gas when you can stretch the make from 1000 to 2000 cubic feet per ton, without any difficulty?
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MEADE-KING, ROBINSON, & CO.
Represent the Strongest Independent Refineries in America; also Petroleum Spirit for Gas Enrichment. 18, EXCHANGE STREET, MANCHESTER, and 11 OLD HALL STREET, LIVERPOOL.

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CARBURINE FOR GAS ENRICHING.
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LONDON, E.C.
Telegraphic Address: "Carburine, London."

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BROTHERTON AND CO., LTD., Tar Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, WAKEFIELD, AND SUNDERLAND.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market,
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

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CORRESPONDENCE Classes in Gas Engineering and Gas Supply start July 1 next.
Full Particulars from the CORRESPONDENCE COLLEGE COMPANY, 26, Green Street, CAMBRIDGE.

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BROTHERTON AND CO., LTD., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, WAKEFIELD, and SUNDERLAND.

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JOHN E. WILLIAMS AND CO.,
LOWER MOSS LANE,
MANCHESTER, S.W.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

RE-ENGAGEMENT wanted as Foreman of Bye-Products Works by a good Chemical Plumber. Sulphate Specialist. GOOD SALT GUARANTEED from any Plant. Excellent References and Testimonials.
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GAS Engineer, at present with one of the largest Corporations in Canada, would be willing to consider Offers from Manufacturers of Gas Plant to devote his whole time to REPRESENTING them in Canada. Has thorough knowledge of the Business, Splendid Connection, and can furnish highest References.
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WANTED, immediately, a Bye-Product Coke-Oven FOREMAN in Yorkshire.
Apply, by letter, to No. 4785, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

BANBURY GAS COMPANY.
WANTED by the above Company (making 60 Million cubic feet) a Young and Energetic MANAGER, to TAKE CHARGE of the Works and act as Assistant-Secretary with the Managing-Director, and also be able to conduct a Gas-Fitting Trade.
Salary £200, with good House, Gas, and Fuel.
There is a strong competing Electric Light Company in the Town.
Apply, stating Age and enclosing *copies* of Two Testimonials, to JOSEPH SAUL, Esq., Chairman of the Company, Mayfield, Banbury, OXON, on or before Tuesday, the 25th of June, 1907.

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(NATURAL.)
SPENT OXIDE PURCHASED.
BALE'S FIRE CEMENT.
PAINT FOR GAS-WORKS
BALE & CHURCH,
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SULPHURIC ACID.
SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.
SPENCER CHAPMAN & MESSEL, LTD.
with which is amalgamated WM. PEARCE & SONS, LTD.
36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, LONDON."
Telephone: 341, AVENUE.

LEEK URBAN DISTRICT COUNCIL.
THE above Council invite Applications for the Appointment of ENGINEER AND MANAGER of their Gas-Works. Preference will be given to those who have had previous experience in a system of Inclined Retorts. The make of Gas for the past Year was 105,710,000 cubic feet.
Applications, addressed to the Chairman of the Gas Committee, and stating age, qualifications, and salary required, to be accompanied by *copies* of three recent testimonials, and delivered at the Town Hall, Leek, not later than Monday, June 24, 1907.
By order,
HAROLD HENSHAW,
Clerk to the Council.
Town Hall, Leek,
June 10, 1907.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

WANTED for the Gas-Works at Hong Kong, a YARD FOREMAN who is a good Carbonizer. One experienced in Water-Gas Plant preferred. Also a GAS-FITTER and Practical BRASS-WORKER. One who understands Lacquering preferred.
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CLAY RETORTS—30 New Retorts, 20 by 14 ⏢'s and 22 by 14 ⏢'s. Will accept 3s. per foot for immediate Sale. New and Perfect.
Apply to FIRTH BLAKELEY COMPANY, Thornhill, DEWSBURY.

FOR SALE—40,000 cubic feet per hour SQUARE STATION METER, with New Drum, &c. Being replaced with a larger Meter.
Can be seen working upon Application to the GAS METER COMPANY, LTD., 238, Kingsland Road, LONDON, or Union Street, OLDHAM.

WE have for Sale 600 Lineal feet of 12-inch Diameter SOCKET and SPIGOT PIPES; also about 200 feet of 9-inch SOCKET and SPIGOT PIPES. Cheap for immediate Sale.
Full Particulars, Weights, &c., on Application to FIRTH BLAKELEY & CO., Thornhill, DEWSBURY.

FOR SALE—Kirkham Washer-Scrubber, 7-inch inlet and outlet Connections, 10-inch Bye-pass and Valve (without Engine). Can be belt driven. In good order. Replaced by larger.
Can be seen working at the DEAL AND WALMER GAS-WORKS on application to the MANAGER.

EXCEPTIONAL Bargain. 50 feet Double-Lift GASHOLDER, 60,000 feet capacity. Must be cleared by June. Splendid Bargain. Equal to new. Sacrificed and Re-erected at Nominal Sum for Immediate Sale.
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NEW SINGLE GASHOLDER, 30,000 ft. capacity.
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GASHOLDERS of varying capacities from 1000 feet to 10,000 feet.
WATER-GAS PLANT for 150,000 feet per day.
GAS-ENGINES, PUMPS, EXHAUSTERS, PURIFIERS, and Sundries.
Inquiries Solicited. Specially Low Prices will be quoted for prompt Sale, either with or without Fixing.
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